EXHIBIT 5

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NORTH CAROLINA
SOUTHERN DIVISION

IN RE: CAMP LEJEUNE WATER LITIGATION,	)	
Plaintiff,	)	No. 7:23-CV-00897
vs.	)	
UNITED STATES OF AMERICA,	)	
Defendant.	)	

VIDEOTAPED DEPOSITION OF: NORMAN L. JONES
FEBRUARY 14, 2025
9:13 A.M. TO 4:34 P.M.

Location: UNITED STATES ATTORNEY'S OFFICE
111 South Main Street, Suite 1800
Salt Lake City, Utah

Reporter: Vickie Larsen, CCR/RMR
Utah License No. 109887-7801
Nevada License No. 966
Notary Public in and for the State of Utah

APPEARANCES

For the Plaintiff:

Laura J. Baughman
Devin Bolton
WEITZ & LUXENBERG
700 Broadway
New York, New York 10003
212.558.5915
Lbaughman@weitzlux.com
Dbolton@weitzlux.com

For the Defendants:

Kailey Silverstein
Giovanni Antonucci
Haroon Anwar
U.S. DEPARTMENT OF JUSTICE
CIVIL DIVISION
1100 L Street, NW
Washington DC, 20005
202.616.4473
Kailey.silverstein@usdoj.gov
Giovanni.antonucci@usdoj.gov
Haroon.anwar@usdoj.gov

Also Present:

McKayla Largin, videographer

Present by Zoom:

Alanna Horan
Bill Williams
Dennis Reich
Deanna Havai
Tim Thompson
Morris Maslia
Jeffrey Davis
Allison O'Leary

-oOo-

I N D E X

-oOo-

E X H I B I T S

	Regarding Tarawa Terrace Flow and Transport Model Post-Audit dated January 14, 2025	
Exhibit 5	Exhibit 2, Resume for Norman L. Jones	55
Exhibit 6	Tarawa Terrace Flow and Transport Model Post-Audit dated October 25, 2024	59
Exhibit 7	Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit dated January 14, 2025	64
Exhibit 8	CE 547 - Brigham Young University Groundwater Modeling Concepts PowerPoint	97
Exhibit 9	ATSDR Chapter A: Summary of Findings	119
Exhibit 10	Letter dated February 13, 2025 from Devin Bolton, with attachment	150
Exhibit 11	ATSDR Chapter F:	161

	Simulation of the Fate and Transport of Tetrachloroethylene (PCE)	
Exhibit 12	Exposure to Contaminants in Water Supplies at Camp Lejeune	166
Exhibit 13	Time Issues	187
Exhibit 14	Augmenting Sparse Groundwater Level Data with Earth Observations vis Machine Learning	207
Exhibit 15	CE En 547 - Exam #2 Key Sample	213
Exhibit 16	Response to the Department of the Navy's Letter on: Assessment of ATSDR Water Modeling for Tarawa Terrace	227
Exhibit 17	New River MCAF, NC Spreadsheet	259
Exhibit 18	An overview of current applications, challenges, and future trends in distributed	269

process-based models in hydrology

-oOo-

February 14, 2025 9:13 a.m.

P R O C E E D I N G S

THE VIDEOGRAPHER: Good morning. We are going on the record at 9:13 a.m. on February 14, 2025. This is Media 1 deposition recording of Dr. Norman Jones, In the Matter of Camp Lejeune Water Litigation filed in the District Court for the Eastern District of North Carolina, Case Number 7:23-CV-00897.

This deposition is being held at the Attorney General's Office in Salt Lake City, Utah.

My name is McKayla Largin. I'm the videographer. And Vickie Larsen is the court reporter.

Will counsel please state who they represent for the video record.

MR. ANTONUCCI: Giovanni Antonucci for the United States.

MS. SILVERSTEIN: Kailey Silverstein for the United States.

MR. ANWAR: Haroon Anwar for the United States.

MS. BAUGHMAN: Laura Baughman for the plaintiffs.

MS. BOLTON: Devin Bolton for the plaintiffs.

THE VIDEOGRAPHER: Will the court reporter please swear in the witness.

NORMAN L. JONES,

called as a witness, having been duly sworn, was examined and testified as follows:

EXAMINATION

BY MR. ANTONUCCI:

Q. All right. Good morning.

A. Good morning.

Q. Please state your full name.

A. Norman Lovell Jones.

Q. And can you please state your current address.

A. 4174 North 430 East, Provo, Utah.

Q. Well, good morning, Dr. Jones. My name is Giovanni Antonucci, as you just heard. I'm an attorney for the Department of Justice. I represent the United States in the Camp Lejeune Water Litigation that's

currently pending in the District Court for the Eastern District of North Carolina.

Dr. Jones, have you ever had your deposition taken before?

A. Yes.

Q. How many times have you had your deposition taken before?

A. Once.

Q. And what was the nature of the case in which you were deposed?

A. I was the class representative on a class action lawsuit against the Traeger company. And I can't remember the exact date, a year and a half, two years ago, I had a seven-hour deposition as part of that.

Q. Is the Trager company the same company that manufactures grills?

A. Yes.

Q. Okay. All right. We'll come back to discuss that, but I'd like to get through a few more sort of ground rules, if that's all right with you.

A. Sure.

Q. So you just took an oath; right?

A. Right.
Q. Do you understand the nature of that oath?
A. Yes.
Q. That oath requires you to fully answer each question. If you're not sure of an answer or don't have a complete answer, you must still answer the question to the extent that you can.
Do you understand?
A. Yes.
Q. As you can see, a court reporter is taking down everything that we say. Because she can only record words, it's important that you answer questions verbally.
For example, you must say "yes" are or "no" rather than shaking or nodding your head. Do you agree to do that?
A. Understood, yes.
Q. Please speak at a slow pace so that the court reporter can record everything. I will do my best to do the same.
We should also try not to interrupt one another; otherwise, our court

reporter will not be able to record us accurately.

Please wait until I finish my question before you start to answer, and I will not interrupt you while you are speaking.

Sound good?

A. Sounds great.

Q. Once the deposition is complete, you'll be given an opportunity to read a transcript of your testimony and make any corrections. You will then be asked to sign it.

Is that all right with you?

A. Sounds great.

Q. Dr. Jones, only you are testifying today. You must answer to the best of your ability and you may not ask others for their help.

Do you understand?

A. Yes.

Q. If you don't understand one of my questions, please let me know and I will try to clarify. However, if you don't ask for clarification, I will assume that you

understood the question; is that fair?

A. Yes.

Q. During the deposition you may hear other attorneys say "objection" and state an objection. Unless you've been instructed not to answer the question, please answer the question after the objection has been made.

Do you understand?

A. Understood, yes.

Q. Is there any reason why you're unable to give your most truthful and accurate testimony today?

A. No.

Q. Is there any reason your memory might be impaired today?

A. No.

Q. Have you taken or do you intend to take today any medication that might affect your ability to testify accurately or honestly?

A. No.

Q. Dr. Jones, you can ask for a break at any time. Please don't hesitate to ask for breaks. All I ask is that you answer

any question that's pending before we go on the break.
Does that sound good?
A. Sounds good.
Q. Am I correct that you've been retained by plaintiff's leadership group as an expert witness in the In Re: Camp Lejeune Water Litigation pending in the United States District Court for the Eastern District of North Carolina?
A. Yes.
Q. When were you hired as an expert witness?
A. September of 2024.
Q. Do you remember the specific date?
A. I don't remember the exact date. Earlier in the month, I believe.
Q. And who hired you?
A. The -- the Bell Legal Group, I think it's called.
Q. Okay. Were you dealing with attorney Kevin Dean at that time?
A. Yes.
Q. Before you were retained, had

you ever heard about Camp Lejeune?

A. I'd heard of it, yes.

Q. Had you heard of the existence of the camp in general, or more specifically the water contamination issues?

A. I'd heard -- I was aware of the existence of the camp, and I was aware that there was some groundwater contamination at the camp, and there was some -- there was -- yeah, I was aware that it was being studied and analyzed.

Q. How did you become aware of the water contamination?

A. You know, I -- I'm not sure I remember. One of those things that I recall knowing vaguely about it, but I never investigated it deeply prior to that time.

Q. Do you recall when you first learned about the water contamination issues at Camp Lejeune?

A. No, I don't.

Q. Was it prior to 2022?

A. I don't think so, but I can't be sure.

Q. Is it possible you learned

about the issues from attorney advertising?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I can't say. I don't remember.

Q. BY MR. ANTONUCCI: Sure. Had you heard about Camp Lejeune in your professional capacity?

A. Again, I -- I don't recall. I didn't know a lot about it, so it's hard for me to pin down where I -- where I heard about it. Just was vaguely aware that there was a groundwater contamination issue there.

MR. ANTONUCCI: Okay. I am going to ask that Exhibit 1 be marked for identification.

(Exhibit 1 was marked for identification.)

Q. BY MR. ANTONUCCI: Dr. Jones, please take a moment to look that over.

A. Okay.

Q. Have you finished reviewing Exhibit 1?

A. Yes.

Q. Have you seen this document before?

A. Yes.

Q. When have you seen it before?

A. It was sent to me, I believe, by email a few weeks ago.

Q. Okay. I'll represent to you that that's the notice of deposition and subpoena that I issued for your testimony here today.

A. Okay.

Q. Does that generally comport with your understanding?

A. That is what I would have guessed, yes.

Q. Okay. I'd appreciate it if you could turn to Attachment A, which is towards the end of the document.

So Attachment A states "Pursuant to Federal Rules of Civil Procedure 39(b)(2) and 45, the United States makes the following requests for the production of non-privileged documents, communications, and materials, including but not limited to, any electronically stored information, data, technical files, and photographs, within your possession, custody, or control:

"Number 1. All emails, letters, correspondence, text messages, conversations, chats, voicemails, data, technical files, or other communications pertaining to Camp Lejeune sent or received prior to your retention as an expert in this matter, including but not limited to, from, or with:

"Morris Maslia, Robert Faye, Jason Sautner, David Savitz, Rene Suarez-Soto, Susan Martel, Scott Williams, Frank Bove, Mike Partain, Jerry Ensminger, Lori Freshwater."

Did I read that correctly?

A. I believe so, yes.

Q. Do you have any emails, letters, correspondence, text messages, conversations prior to your retention with any of those individuals?

A. Not related to Camp Lejeune.

Q. Do you have any emails, letters, correspondence, text messages, conversations, chats, voicemails, data, technical files or other communications pertaining to Camp Lejeune prior to your

retention -- excuse me -- not pertaining to Camp Lejeune from prior to your retention with any of those individuals?

A. Yes.

Q. May I ask who?

A. Morris Maslia.

Q. Okay. What sort of communications had you had with Mr. Maslia prior to your retention as an expert in this case?

A. So -- so for several years he and I both served together on a peer-review panel for a research project at the University of Alabama, and I was the chair of that expert panel and Morris was a member of the panel.

So in the context of reviewing that research project, we had correspondence.

Q. Okay. Before we discuss that more, is there anyone else on that list with whom you've had any communications prior to your retention as an expert in this case?

A. No.

Q. Other than your dealings with the expert panel and Mr. Maslia, do you have

any other communications with him prior to your retention as an expert?

A. No.

Q. Okay. So you mentioned that your work with Mr. Maslia was through the University of Alabama; is that right?

A. Yes. There's a -- a National Science Foundation-funded project where the principal investigators at the University of Alabama, it also involves other universities, Louisiana State University, University of Mississippi, Auburn, a number of other smaller universities.

Q. And you mentioned serving on an -- or excuse me -- serving as the chair of an expert panel on which Mr. Maslia also served; is that right?

A. That's correct.

Q. What were you evaluating?

A. So based on the rules and protocols for that grant established by the National Science Foundation, they were required to, every year, bring in an outside panel to review their work to give feedback, make sure they're following good research

standards and making good progress.

And so once a year we would read the report that they had generated, and then we would travel to Alabama and participate in a two-day workshop, presentations, and then we would write a report with recommendations and observations we make during the review process, and we did that three times.

Q. Okay. So you've mentioned providing feedback, ensuring good research standards, and good progress?

A. Yes.

Q. What is the project that you were evaluating for those criteria?

A. It was a very broad project, but the primary objective was to do research on groundwater in -- in the Southeast United States. Looking at groundwater recharge, looking at evaluating groundwater storage change, things like that.

And they also used, developed, and applied some groundwater models as part of the project.

Q. So my understanding of recharge

and storage change is that those are parameters that pertain to the amount of water contained in an aquifer; is that right?

A. Yeah, recharge is typically the water that comes from rainfall that as a portion of that eventually percolates down and enters the aquifer. It's the primary source of water to an aquifer.

And then the storage change is -- it's dependent on the water balance, how much water is coming in versus how much water is being discharged to springs and streams and being pumped out by wells.

Q. And you mentioned this was the Southeast United States. Was this the Floridian aquifer?

A. They studied, I know, aquifers in Mississippi and Alabama, and there was a very large model built in the state of Louisiana by the researchers from Louisiana State University.

Q. What was the purpose of the applied groundwater models that they were developing?

A. Partially to look at storage

change and aquifer sustainability. And, again, determination of recharge rates was one of the things that was studied.

And they're also looking at, I believe, innovative numerical algorithms and methods for analyzing aquifers, determining recharge rates.

For example, the -- they used not just in-situ data from monitoring wells, but earth observations from satellite data.

Q. So I'd like to sort of break that down a little bit more with you.

A. Sure.

Q. You mentioned that the purpose of evaluating storage change and recharge is to evaluate aquifer sustainability; am I stating that correctly?

A. That's one of the purposes, yes.

Q. Okay. What are the other purposes?

A. To -- water resource planning. When your -- groundwater is one of our most significant sources of fresh water. For example, in a drought when the stream flow is

low, sometimes you pump more groundwater to make up that deficit, so it's a -- it's a large, underground reservoir.

So much of the work we do in groundwater studies is to assess how our groundwater storage is changing over time and how to characterize that and how to predict how it will respond in the future, and that happens to be one of my -- one of my areas of research as well.

Q. So if I'm understanding correctly, the purpose of this project at the University of Alabama was, at least in part, to assess sustainability for planning purposes; is that right?

A. That's one of the objectives, that's right.

Q. Okay. Can you please list the other objectives.

A. You know, it's been almost two years since our last review, so I'm not sure I could add much beyond what I've stated in terms of detail without looking up the reports and reviewing it.

Q. Sure.

A. You know, and a big part of the project is also public education and outreach. So they -- they had a lot of funding to -- to work with K through 12 and provide high school science teachers, for example, with material and understanding aquifers and aquifer dynamics.

And so it -- it was a -- it was a very broad project. They looked at machine learning algorithms for different kinds of data analysis related to groundwater data. It was very broad.

They had, I think, maybe as many as 80 people on this project. It was one of the bigger research projects I've ever seen.

Q. What was the process like to be selected as the chair of the expert panel?

A. I -- so I was the princ- -- this grant was through what's called the EPSCoR project, E-P-S-C-O-R, the EPSCoR program through the National Science Foundation.

And from 2010 to 2014 I happened to be the principal investigator of

an EPSCoR grant, a $6 million EPSCoR grant featuring Brigham Young University, University of Utah, Utah State University, and University of Wyoming.

And the -- the principal investigator of the project centered in Alabama. It was an associate of mine and he was aware of that and thought that my experience and also my general background and experience in groundwater would -- would make me a -- a good pick for that role.

Q. And do you know how any of the other panel members were selected?

A. They were selected by the -- they were asked to serve on behalf of the principal investigator of that project, which is Prabhaker Clement.

Q. You mentioned previously that part of the objective of the expert panel was to provide feedback, evaluate research standards, and ensure good progress?

A. Yeah.

Q. Am I stating that correctly?

A. Right.

Q. What kinds of -- of research

standards were you looking for in this project?

A. Well, they would make presentations on -- on their findings and the methodologies they were using, review journal articles that they had published or in the process of working on and, you know, in some cases we would give advice on -- on methodology, suggestions on -- on different kinds of computer algorithms to help, you know, based on our experience.

But, overall, it was a very impressive project and they -- they've been doing excellent work.

Q. You mentioned --

A. So we didn't -- we didn't -- I don't recall any highly critical feedback that we gave. Fortunately, it's a really -- really well-run project.

Q. So you just mentioned evaluating the methodology; is that correct?

A. Yeah.

Q. How did you go about evaluating the methodology of this groundwater modeling project?

A. We would review the reports that they provided, the papers that they were -- that they had -- they were either preparing to submit or publishing, and two days of presentations that they would make each year.

Q. Were you provided with the modeling files to evaluate?

A. No.

Q. Did you perform a post-audit of any kind of their work?

A. No.

Q. I'd like for you to sort of walk me through the process of evaluating the methodology of a groundwater modeling project --

A. Sure.

Q. -- if that's all right.

A. Yeah.

Q. I guess maybe we can start with the conceptual model.

A. Yeah.

Q. My understanding is that's kind of where modeling begins; is that right?

A. That's right.

Q. So what did you do to evaluate the conceptual model of this project from the University of Alabama?

A. Well, there's not one model, there were -- there were multiple models. The -- they provided a general description of the conceptual model, and for the Louisiana model there was a presentation and some written material where they described the basic components of the conceptual model.

Q. Did your evaluation of the conceptual model involve evaluating the purpose for which the model was designed?

A. They -- they described the purpose, I believe, that -- in -- in -- for the Louisiana model, it was to look at water availability and long-term, again, sustainability, water balances.

Q. And, again, that's for planning purposes; right?

A. But that's -- I'm going by memory. I'm quite sure that's what it was, but it's been a while.

Q. Of course. Completely understandable.

The -- what you just stated, the evaluating sustainability and planning purposes. My understanding is that your primary memory of what the projects are for as it stands today is that it was a planning project; is that right?

A. They -- I -- what -- from what I recall, it's been a while, it was develop a very sophisticated model of the aquifers in Southern Louisiana to characterize the groundwater flow and the long-term changes in groundwater storage --

Q. And it was --

A. -- and then the dynamics of the aquifer.

Q. Excuse me. I didn't mean to cut you off.

That was to determine the future availability of groundwater?

A. It's one of the objectives, I believe, yes.

Q. Okay. And you can't remember any other objectives today?

A. No.

MS. BAUGHMAN: Objection.

Form.

Q. BY MR. ANTONUCCI: All right. You mentioned there were multiple models that you were evaluating. Can you provide a general overview of what those models were.

A. I don't remember the other cases as well. I'm not sure there were models as much as aquifer studies. That's the one I remember most, because it was the most significant model, Louisiana model. I'm not sure I could comment on the others. My memory is more fuzzy with regard to that.

Q. Okay. Moving on from the conceptual model. Did you evaluate their selection of a mathematical model?

A. I know they -- they used MODFLOW.

Q. Okay. Are there different options for equations -- governing equations that can be used in MODFLOW?

A. No. There's one governing equation that the model is built around.

Q. Okay. Did you evaluate the process of model calibration?

A. That was part of what they

presented, yes.

Q. Okay. What factors did you look at when evaluating calibration?

A. Just -- I -- I don't remember the details. I remember they -- they did an extensive calibration process, but it seemed fairly standard, as I recall.

Q. Do you know if they used perimeter estimation tools?

A. I don't remember for sure, but I believe they did. It's fairly typical to use automated parameter estimation on a large model like that.

Q. Is it also typical to do some manual parameter estimation as well?

A. Oh, yes. Yeah, always.

Q. Do you generally start with manual parameter estimation?

A. In general --

MS. BAUGHMAN: Objection. Form.

THE WITNESS: It's generally good practice to start with manual calibration before you engage the use of software to help calibrate a model.

Q. BY MR. ANTONUCCI: My understanding is that one of those software codes is called PEST for parameter estimation; is that right?
A. That's correct.
Q. That was created by John Doherty?
A. That's correct.
Q. Do you know if the model you evaluated used the PEST code?
A. I don't recall.
Q. What other factors did you evaluate for in your analysis of their calibration?
A. I don't recall.
Q. Did you evaluate the sensitivity analysis performed by the investigators of the study?
A. I don't recall.
Q. Is it typical to analyze the sensitivity analysis of a groundwater model when reviewing the methodology?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: Will you state

that again.

Q. BY MR. ANTONUCCI: Sure. I'll -- I'll restate my question.

When you are evaluating a groundwater model's methodology, is it typical to evaluate the sensitivity analysis?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: If -- if they performed a sensitivity analysis, you would review that, yes.

Q. BY MR. ANTONUCCI: Okay. So based on that answer, it seems like it's not a guarantee that a sensitivity analysis will be done for every model; is that right?

A. Not necessarily.

Q. Okay.

A. Yeah.

Q. How about uncertainty analysis? Is that typically done for most models?

A. It is done for some models.

Q. Okay. What factors do you look at when you're evaluating uncertainty analysis?

MS. BAUGHMAN: Objection.

Form.

THE WITNESS: When I'm -- when you're performing a sensitivity analysis on the model? Is that the question?

Q. BY MR. ANTONUCCI: I'm asking now about as a peer reviewer --

A. Yeah.

Q. -- when you're evaluating the methodology of a groundwater model, you're looking at the uncertainty analysis. What factors do you look at?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: The methodology they use to perform the uncertainty analysis.

Q. BY MR. ANTONUCCI: Can you elaborate on that? What -- what are the sort of --

A. Well --

MS. BAUGHMAN: Objection. Form.

THE WITNESS: There are different ways one can go about an

uncertainty analysis, but the general process is typically basically the same from one case to another.

Q. BY MR. ANTONUCCI: Okay. Can you explain that general process.

A. Well, typically one would first calibrate a model to come up with a best estimate of the parameters of the model and the features of the model that reproduce the -- the behavior exhibited by the aquifer in the field.

And then -- then you look at your parameters and for -- for the selected set of parameters, you look at the uncertainty in that parameter typically with the use of a probability distribution function.

And then to perform the uncertainty analysis, you generate a large number of model instances, versions of the model. In each case where -- for the parameters you've selected, you perturb the parameter value within the range of values you determined would be reasonable to expect for that parameter.

And that gives you a -- a number of models. And if you do it right, each of those models are considered equally probable.

And then you run your simulation for each of those, and then you evaluate the outcome you're looking at, and then you can get that -- that allows you to get a probability of a certain outcome or a confidence interval for a range of outcomes, and this is often called a Monte Carlo process.

Q. The uncertainty analysis is evaluating the probability of all possible model solutions; is that right?

A. Of a range of model solutions that are considered to be likely or probable as being -- or considered to be possible. Variations of the model.

Q. All right. Thank you. I didn't mean to sidetrack the discussion so much with that. I appreciate you providing that information. You can put Exhibit 1 to the side, please.

What did you do to prepare for

your deposition today, Dr. Jones?

A. I primarily reviewed the -- the ATSDR reports and our model reports.

Q. I see that you have some stacks of paper in front of you; is that right?

A. Yeah.

Q. What are those?

A. I have Chapter A, ATSDR Chapter A. Chapter F. And then I have a copy of the rebuttal report that Jeff Davis and I submitted in January of this year.

Q. And I see those are tabbed with sticky notes; is that right?

A. That's correct.

Q. What sections did you tab in Chapter A?

A. I put some tabs in for some figures that I thought -- primarily figures I thought might be useful that I think are important in the -- in the analysis -- in the review of the work, one of which is Figure A18, Chapter A. Another of which is A26 in Chapter A.

And in Chapter F I have tagged Figure F12, the scatter plot simulated versus

observed for the MT3DMS model. Page F34 which shows the -- the time series of PCE at Well TT-26 versus the observed values. And F43, which is the simulated and observed concentrations at the Tarawa Terrace water treatment plant.

Q. Did you make any handwritten notes in those?

A. No.

Q. Did you make any highlights?

A. No.

Q. Did you do anything other than tab those documents?

A. No.

Q. And I see you also have the rebuttal report; is that right?

A. Yes. In the rebuttal report I have tagged the "Summary of Opinions" page, I have tagged at the beginning of the figures page and -- or excuse me -- the figure section in case I want to refer to some of the figures. Specifically Figure 2 and Figure 5.

And then I've tagged the -- where the maps of the contaminant plumes

begin in the Appendix A7.

Q. Did you make any notes in your copy of the rebuttal report?

A. No.

Q. Did you make any highlights?

A. No.

Q. Did you do anything other than tab the pages you just mentioned?

A. No.

Q. So, Dr. Jones, I'm sorry to do this, but I'm going to ask you to put those to the side to --

A. Okay.

Q. -- ensure we're looking at the same copies of the documents today.

A. That's fine.

Q. Thank you. I appreciate that.

MS. BAUGHMAN: But obviously if he wants to refer to his copies, he can.

MR. ANTONUCCI: We're going to use the copies that were produced.

MS. BAUGHMAN: He can refer to his tabbed copies if he wants to.

MR. ANTONUCCI: We can tab the

produced copies at a break.

MS. BAUGHMAN: Norm, you can -- you can look at your version if you want to, if it's helpful. It's the same thing.

MR. ANTONUCCI: All right, then I'm going to ask that those be marked as exhibit.

MS. BAUGHMAN: That's fine.

MR. ANTONUCCI: All right.

Q. So other than reviewing those documents which you've tabbed, have you done anything else to prepare for your deposition?

A. Just discussed with the legal team the format and what to expect. The procedure and methodology.

Q. When you say "legal team," are you referring to Ms. Baughman and Ms. Bolton?

A. That's correct.

Q. Are you also referring to Mr. Dean?

A. No -- there were -- I guess he was briefly involved in some of the discussions, yeah. Yeah, he was involved.

Q. Were there any other attorneys

you spoke with?
A. Not that I recall, no.
Q. Was anyone else present at those meetings?
A. Jeff Davis.
Q. Was Mr. Davis present for every meeting you had with the legal team?
A. No. Most of them.
Q. Other than Mr. Davis, was anyone else present?
A. No.
Q. Approximately how many times did you meet with the legal team to prepare for this deposition?
A. We met on Monday -- or excuse me, I'm sorry -- Wednesday of this week. We had dinner on Tuesday night. Had dinner last night.
Q. Approximately how long was your Wednesday meeting?
A. Six or seven hours, I would guess.
Q. Okay. What did you discuss in that meeting?
A. Again, what to -- how -- how a

deposition works. What -- what types of questions would -- we would expect to be asked. Don't talk over the question when it's being asked. Allow time for -- don't start speaking too soon. Allow time to make an objection, if necessary.

A lot of procedural coaching like that.

Q. Was there anything else?

A. Just a general review of the case and rebut- -- our opinions, and so forth.

Q. Were you provided with any documents in those meetings?

A. I don't recall, no.

Q. All right. Have you reviewed any of the other depositions taken in this case?

A. I reviewed the prelim- -- the draft transcript of the Mustafa Aral deposition that was taken recently. And I was on the Zoom yesterday. I watched most, but not all, of the Jeff Davis deposition.

Q. Have you reviewed any other depositions that have been taken in the Camp

Lejeune Justice Act litigation?
A. No.
Q. So you mentioned testifying in a deposition. I'm interested, have you ever testified at trial?
A. I testified at a court hearing in the -- in Carson City, Nevada, in front of the state engineer as part of a water rights dispute on two occasions where I was put under oath and questioned as an expert witness.
Q. Did you prepare a report in those cases?
A. Yes.
Q. But you weren't deposed?
A. I was not deposed, no.
Q. So you mentioned it was a water rights dispute. Can you --
A. Yes.
Q. -- explain in laymen's terms what that means.
A. So the -- the City of Las Vegas back in the 1980s decided that they needed to do something to ensure long-term water availability, and this organization later was

renamed The Southern Nevada Water Authority, it represents primarily Las Vegas, but also surrounding cities.

And they decided to pursue a groundwater development project where they would drill a series of deep production wells in some valleys in East Central Nevada, and build 300 miles of large pipe to pump that water south to Las Vegas.

It would have been a $15 billion project, would have taken estimated 27 years to build. Would have been the largest inter basin transfer in history, the largest groundwater development project in history, and it would, as you can imagine, extract a significant amount of water from these valleys.

And I represented a significant landholder. I was -- I was retained as an expert witness for a landholder in Spring Valley that was one of several parties that were protesting the groundwater project.

And, yeah, we did a bunch of modeling simulations and wrote a series of reports related to the impact that project

would potentially have on the water rights, springs and streams and wells in the -- in this valley.

Q. How long ago was that?

A. I started in 2010 and the project -- it went on for ten years until it was concluded in 2020.

Q. Okay. So you already mentioned that you were deposed in a class action lawsuit where you served as a class representative. Is that suit ongoing?

A. It -- they've -- have -- there's been a settlement in the last few months, so it's -- I think it's over.

Q. Okay. Other than that class action, have you ever been involved in any other litigation personally, not as an expert?

A. Involving me? No.

Q. And you mentioned starting work for the landholder in Spring Valley in 2010. Was that your first time serving as an expert witness?

A. No.

Q. When did you serve as an expert

witness prior to that?

A. Several years prior to that I was retained as -- to do a review of a case in Montana that a colleague of mine was involved with as the primary expert witness involving groundwater contamination at a -- at a railroad facility.

Q. Who was that colleague?

A. Willis Weight.

Q. And do you recall which party you represented in that -- or excuse me -- for which party you served as a witness in that case?

A. So Willis was hired as an expert to -- on the side of some plaintiffs who lived adjacent to a railroad facility, Burlington Northern and Santa Fe, and their contention was that contaminants had leeched from an unlined pond or a poorly lined pond on the railroad facility and migrated under a neighborhood where they -- they had some drinking water wells, and that had caused some -- some health damages.

And so Willis built a MODFLOW and MT3D model simulating the migration of

the plume over to the property, and that was entered as evidence in the case.

And then the railroad hired Papadopoulos & Associates to -- to represent their side, and they -- the expert from Papadopoulos did a critical review of Willis' model.

So I was hired to review Willis' work and the Papadopoulos critique of his work and then write a report, which I believe became an affidavit that was entered in the case.

Q. So that I can understand, were you hired as an independent expert by the court or were you hired by --

A. No, I was hired by the plaintiff attorneys.

Q. Okay. So you submitted an affidavit in support of the plaintiff's reports; is that right?

A. It was based on my review of -- of his modeling and the critique of that, yeah.

Q. Other than that Montana case, have you served as an expert witness in any

other cases?

A. Not that I recall.

Q. Do you know who specifically from S.S. Papadopoulos & Associates was the expert in that case?

A. I don't. It's been a number of years. No, I don't recall his name. He was one of their lead modelers, very well respected, I remember that.

Q. What was the contaminant of concern in that case? The Montana case.

A. Boy, it's been a long time. I know that it was a degreasing facility, but it might have been creosote. I wish I could remember. It's been probably 15, 20 years, yeah.

Q. Do you have an opinion about S.S. Papadopoulos as a firm?

MS. BAUGHMAN: Objection to form.

THE WITNESS: No.

Q. BY MR. ANTONUCCI: And you mentioned that your -- your colleague, Mr. Willis, simulated the flow of contamination through the -- through the

groundwater; is that right?
A. That's correct.
Q. And that was from the poorly lined pond to water supply wells; is that correct?
A. To the -- yes, to the area downgradient from the railroad facility where the water was pumped out, yeah.
Q. How far away from the pond were the water supply wells?
A. It -- it wasn't a great distance, but I -- I don't remember the exact distance.
Q. Do you know the total size of the area that was modeled?
A. I don't recall.
Q. And do you know what information was used to, for example, to select boundary conditions in that model?
A. I don't recall.
Q. Do you know what information was available in terms of heads and flow data?
A. I don't recall specifics.
Q. Do you know if there was heads

and flow data available to Mr. Willis?
A. I -- I believe there were, yes.
Q. Why do you believe that?
A. I -- if -- if there were not any data -- I know they had concentrations at the -- at the location where the water was being pumped out. That was the whole basis of the suit was they measured contaminants in their drinking water.
Q. When you say "the location where the water was pumped out," are you referring to the supply wells, the water treatment plant, or the tap?
A. I don't believe a water treatment plant was involved. There were -- I -- from -- from what I recall, there were some small wells. I believe it was actually a -- part of a -- an Indian reservation, and they had some small water supply wells they were using.
Q. So it sounds like those samples were taken at the supply wells?
A. Yes, I believe so.
Q. Do you know approximately what time span those samples covered?

A. I don't recall.
Q. Was it more than a year?
A. I don't recall.
Q. Was it less than a year?
A. I don't recall.
Q. Do you know approximately how many data points they had?
A. I don't recall.
Q. Did they have -- strike that.
With regard to the -- the head and flow data that you assumed that they had available, do you know how much of that was available?
A. I don't recall.
Q. Where do you -- in these kinds of cases, where do modelers normally get head and flow data from?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: Head and flow data? Well, you track down water level measurements from observation wells. In some cases, aquifers interact with streams, either discharge to streams or streams leak

water into the ground.
Sometimes you can look at gauges on the stream to get an estimate of -- of how much water's being gained or lost, but that is a fairly standard part of the data collection phase on the modeling project is to gather all the data you can find.
Q. BY MR. ANTONUCCI: Okay. And you mentioned that it was a lawsuit brought on behalf of the individuals who drank the water from those wells; is that correct?
A. That's correct.
Q. Do you know if the purpose of the model was to determine the absolute amount of contaminants that these individuals were exposed to?
MS. BAUGHMAN: Objection to form.
THE WITNESS: I don't recall. I know part -- at least part of the purpose was to determine if, presuming water leaked from the pond, would it, given the groundwater flow directions

and the timing, is it probable that it traveled -- that the contaminants were transported to that location where they could potentially be pumped out.

Q. BY MR. ANTONUCCI: So that's kind of a yes-or-no question, right? Like, could the contamination have gotten to the well in that time period or not; right?

A. Yeah.

Q. Okay. And that's the only purpose that you recall from that report?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: That is a purpose that I recall.

Q. BY MR. ANTONUCCI: What other purposes do you recall?

A. I -- I don't recall other purposes.

Q. Okay. Okay. So prior to that Montana case, had you ever served as an expert witness before that?

MS. BAUGHMAN: In litigation?

MR. ANTONUCCI: Yes, in litigation.

MS. BAUGHMAN: Object to the form.

MR. ANTONUCCI: Have you -- excuse me. I'm going to ask my question again.

Q. Prior to the Montana case, had you ever served as an expert witness in litigation?

A. I don't believe so. Not that I recall.

Q. Okay. Do you have a list of all the times you've served as an expert witness somewhere?

A. No.

MR. ANTONUCCI: Okay. All right. Actually, before we move on, I'm going to ask that the copies that you brought of the rebuttal report and Chapters A and F be marked for identification for Exhibits 2, 3, and 4.

(There was a discussion held off the record.)

(Exhibits 2-4 were marked for identification.)

MR. ANTONUCCI: Thank you for

that.

And now I'm going to hand you another document. I'll ask that this be marked for identification as Exhibit 5.

(Exhibit 5 was marked for identification.)

Q. BY MR. ANTONUCCI: Please let me know when you've had a chance to review that document.

A. I'm ready.

Q. Okay. Do you recognize Exhibit 5?

A. Yes.

Q. Okay. What is Exhibit 5?

A. This is the CV that I submitted.

Q. Okay. So if you turn to Page 1 of Exhibit 5, it looks like this document is titled "Norman L. Jones, PhD, Professor, Department of Civil & Construction Engineering, Brigham Young University"; is that right?

A. Correct.

Q. Is this a complete and accurate copy of your resum??

A. Yes.
Q. Is there anything that you would like to change or add to this copy of your resum??
A. Can you clarify what you mean by "complete"?
Q. Sure. Is -- is this the most updated iteration of your resum??
A. This is the resum? -- resum? that I am currently using when my resum? is requested.
Q. Okay. So I'm inferring from your question that there's some things that are probably left off of this resum?; is that right?
A. That's correct. It's not 100 percent inclusive of everything I've done in my professional career.
Q. Sure. What kind of things are currently listed on your resum? that's marked as Exhibit 5?
A. Oh, heavens. Consulting projects, expert witness work, workshops and courses I've taught, things like that.
Q. Have you served as a consulting

expert in litigation?

MS. BAUGHMAN: Objection to form.

THE WITNESS: A consultant -- not beyond the cases we've described.

Q. BY MR. ANTONUCCI: Okay. Your resum? mentions a bachelor's, master's, and PhD in civil engineering. Did you have any specialization or concentration in those programs?

A. Yes. My master's degree and PhD at the University of Texas, I specialized in geotechnical engineering.

Q. And is there a list of your peer-reviewed publications from the last ten years on Page 3 of this resum??

A. Yes.

Q. How many of these publications deal with groundwater flow modeling?

A. You'll have to give me a minute. I would say of these, six are -- five or six are directly related to a groundwater flow model and -- but a large number of them are for characterizing groundwater conditions, groundwater

sustainability.

Q. And how many of those deal with contaminant fate and transport modeling?

A. I'm not sure in this period -- I got to read them again. I can see at least one.

Q. So just the one?

A. I believe so.

Q. Would it be fair to say that you focus more on groundwater flow modeling than contaminant fate and transport modeling?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: In terms of my publications, yeah, I've -- my -- I've done more research on -- well, in the last ten years, the focus of my research has been more shifted to using earth observations and machine learning and data analytics to analyze aquifers.

MR. ANTONUCCI: I'd like to talk to you about that more later in the deposition. For now, it's been about an hour, would you like to take

a break?

THE WITNESS: Sure.

MR. ANTONUCCI: Okay.

MS. BAUGHMAN: If you're -- if you're willing to keep going, we can. We don't have to. That's up to you.

THE WITNESS: I can keep going.

MR. ANTONUCCI: Well, I'd like to take a break.

THE WITNESS: Sure. All right.

THE VIDEOGRAPHER: Off the record. The time is 10:18.

(There was a break taken.)

THE VIDEOGRAPHER: We're back on the record. The time is 10:28. This is Media Number 2.

Counsel may proceed.

MR. ANTONUCCI: All right. I am going to hand you what is being marked for identification as Exhibit 6.

(Exhibit 6 was marked for identification.)

MR. ANTONUCCI: Sorry, I just noticed my microphone wasn't on.

Q. I just handed you what was

marked for identification as Exhibit 6.

Dr. Jones, this is your initial expert report and materials considered; right?

A. Correct.

Q. And looking at that first page, the cover page, title is Tarawa Terrace Flow and Transport Model Post-Audit prepared for Bell Legal Group. A couple lines down, prepared by Norman L. Jones, R. Jeffrey Davis.

Is that your signature there?

A. Yes.

Q. Okay. How do you know Mr. Davis?

A. He was a former graduate student of mine when I was a young professor at Brigham Young University. And then I hired him to be a staff member in our research laboratory where we were developing groundwater modeling software.

And then I worked with him in that capacity for several years, and then even after he left the university I -- we worked together on consulting projects and

teaching groundwater and contaminant transport modeling short courses.

Q. So it's fair to say that you've worked together before your work on this case?

A. Yes.

Q. And it appears that you co-wrote this expert report; is that correct?

A. That's correct.

Q. Did you participate in the drafting process with Mr. Davis?

A. Drafting?

Q. I guess can you explain to me your -- your role in the preparation of this report.

A. Yes. We decided it would be beneficial to team up. I have certain limitations on my time given that I'm a full-time university professor, and we decided that we would work together, we could share the workload.

And so he did most of the modeling work in terms of entering the data into the GMS MODFLOW MT3DMS software and running the model simulations.

I did a lot of the post-processing and data analysis. Together we -- we reviewed the -- the data, reviewed the -- the prior publications from ATSDR, and then we -- together we drafted and edited and finalized this report.

This report also -- in the preparation of the report we utilized staff at Integral Consulting. For example, the -- the figures with the maps. We provided the model results to staff members at Integral and they helped do a lot of the formatting.

There was also a professional copy editor that reviewed the documents before we submitted them.

Q. A moment ago you mentioned that Mr. Davis used GMS, which I believe incorporates MODFLOW and MD3DMS; is that right?

A. That's correct. It's what we call a pre and post processing for MODFLOW and MT3DMS. It -- the input files to MODFLOW and MT3DMS are very large and complicated and synthesize a lot of data. And so GMS was developed to streamline and simplify that

process and encapsulate it in what we call a graphical user interface.

It -- you can -- you can modify the input files through the GMS interface, for example, save the modified files, run -- and then GMS will then launch MODFLOW and/or MT3D, and then they generate a set of output files which are ingested to GMS for -- for visualization plotting.

Q. And you and Mr. Davis developed GMS for the Department of Defense; is that right?

A. That's correct. We were -- it was developed, yeah, in the early part of my career.

Q. Okay. Turning your attention back to Exhibit 6, your initial report. And, by the way, if I refer to this --

A. Okay.

Q. -- as your initial report, will you understand what I'm saying?

A. Sure.

Q. Okay. Do you agree with all of the opinions and statements made in Exhibit 6?

A. Yes.

Q. And then I'd appreciate it if you could turn to the back, because I've appended your materials considered list.

So is this a fair and accurate copy of your initial report and materials considered list?

A. Yes.

Q. Okay. Thank you, Dr. Jones. You can put that to the side.

I'm now going to hand you what will be marked for identification as Exhibit 7.

(Exhibit 7 was marked for identification.)

MS. BOLTON: For the record, a revised copy of this materials list, it was served after this initial one.

MR. ANTONUCCI: For the rebuttal report?

MS. BOLTON: No. This is the October 2024 report, so for the initial report.

MR. ANTONUCCI: Okay.

MS. BAUGHMAN: Do you want us to send that to you so that you can

mark it or?

MS. BOLTON: Yeah, it includes all of those, plus additional.

MR. ANTONUCCI: That's right. Yes, if you could send it, that would be great.

MS. BOLTON: Okay.

Q. BY MR. ANTONUCCI: Okay. Dr. Jones, I showed you what's been marked for identification as Exhibit 7. This is a report titled "Rebuttal Report Regarding Tarawa Terrace Flow and Transport Model Post-Audit"; is that right?

A. That's correct.

Q. Is this the -- if I refer to this as your rebuttal report, will you understand that I'm referring to Exhibit 7?

A. Yes.

Q. Okay. And, again, it looks like it says "Prepared by Norman L. Jones" with your signature on the front page; is that right?

A. Yes.

Q. And, again, I appended the materials considered to the end of this

report.

A. Yes.

Q. Did you participate in the drafting of this report in the same way as with your initial report?

A. Yes.

Q. Were there any changes in how you and Mr. Davis divided labor?

A. No.

Q. So it's fair to say you undertook substantially the same process to draft both reports?

A. That's correct.

Q. Do you agree with all of the opinions made in Exhibit 7?

A. Yes.

Q. Do you hold every opinion in Exhibit 6, that's your initial report, as your own opinion?

A. Yes.

Q. Do you hold every opinion in Exhibit 7, your rebuttal report, as your own opinion?

A. Yes.

Q. Is there anything in either

report that you believe is incorrect or needs updating?

A. Well, there were some -- can you clarify what you mean by that? You mean in how it's written?

Q. I think you might be referring to the changes that were made to the post-audit --

A. Correct.

Q. -- in between the initial and rebuttal report; is that right?

A. Correct.

Q. So other than those changes, is there anything incorrect in either report?

A. Not that I can think of.

Q. Okay. Is there anything that needs to be updated in either report?

A. Not that I can think of.

Q. Is any portion of either report incomplete?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Not that I can think of.

Q. BY MR. ANTONUCCI: Okay. So

Exhibit 6 and 7, your initial and rebuttal reports, do these include all of the opinions you hold regarding ATSDR's groundwater flow and transport models for Marine Corps Base Camp Lejeune?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Can you clarify what you mean by that.

Q. BY MR. ANTONUCCI: Do you have any opinions on ATSDR's water modeling efforts at Camp Lejeune that are not contained in either Exhibit 6 or Exhibit 7?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yeah, I -- I'm not sure I'm comfortable saying I would never have any other opinions than what are contained here.

Q. BY MR. ANTONUCCI: Sure. In what sort of circumstances would -- would you have a new opinion?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Well, if you were

to ask me about specific questions related to different parts of the modeling that's done in Chapter A and Chapter F by ATSDR, there may be specific opinions about that, which I'd be happy to share that it may not be 100 percent included in these reports.

Q. BY MR. ANTONUCCI: Do you intend to offer any opinions that are not in this case -- strike that.

Do you intend to offer any opinions in this case that are not contained in Exhibit 6 or Exhibit 7?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: In the context of this deposition?

Q. BY MR. ANTONUCCI: I'm referring to the entire case.

Do you intend to offer any other opinions in this case that are not contained in either Exhibit 6 or Exhibit 7?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: If requested by our legal team, I would be willing to provide additional opinions.

Q. BY MR. ANTONUCCI: As you sit here today, do you have any additional opinions about ATSDR's water modeling efforts at Camp Lejeune that are not contained in either Exhibit 6 or Exhibit 7?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yes, there are things about their initial report that I -- I would be happy to proffer as opinions in this deposition that aren't necessarily contained in this report.

Q. BY MR. ANTONUCCI: Okay. Can you list those for me, please.

A. Well, what I'm saying is in the context of -- of this discussion, there may be specific features in the context of the Monte Carlo simulation, the -- the confidence interval, the calibration exercise that may not -- I'm uncomfortable saying every opinion I have is exclusively contained in this.

Q. So -- so to be clear, then, the answer is no, all of your opinions are not contained in your reports?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: In the context of what I just described, yes. I'm hesitant to say everything, all of my opinions are here, and then later be told I can't render an opinion on something because I was told all of my opinions are in here, if you catch my drift.

Q. BY MR. ANTONUCCI: Can you explain why all of your opinions aren't in your report?

A. These reports had a specific purpose and we were asked to do a post-audit, and then report the results of that. And then we were asked to respond specifically to a rebuttal to our post-audit offered by Mr. Spiliotopoulos.

And we -- so the purpose of these documents, to my understanding, was very specific and focused.

Q. Dr. Jones, do you understand that you've been retained as an expert in this case?
A. Yes.
Q. Do you understand the Federal Rules of Civil Procedure require you to disclose a complete list of your opinions?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: I'm not aware of that rule.
Q. BY MR. ANTONUCCI: Can you provide me with a list of the opinions you have that are not contained in your reports?
A. I don't have a list, no.
Q. Can you name a single opinion you have that's not contained in your reports?
A. I -- I would -- I would have to think about that.
Q. Okay. We'll come back to this.
A. Okay.
Q. If you could, please turn to Page 6-1 of Exhibit 6, that's your initial report.

A. Sure.
Q. Page 6-1 of Exhibit 6 has the heading "Conclusions"; is that right?
A. Correct.
Q. And there's a list of five categories of conclusions on this page; is that right?
A. Correct.
Q. Is this a complete list of all the conclusions from your report?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: These are the conclusions from our report, yes.
Q. BY MR. ANTONUCCI: Are there any conclusions from your initial report, Exhibit 6, that are not contained in this list?
A. No.
Q. Am I correct in understanding that this is not a complete list of all the opinions you will render in this case?
A. It's a -- given the context of what we're asked to do, this is a complete list of the -- of the opinions relative to

this. And I've not been asked to formally submit any additional opinions at this time.

Q. Okay. Does any part of this list need to be updated?

A. Not --

MS. BAUGHMAN: Other than with the rebuttal? I mean, I object to the form.

THE WITNESS: No.

Q. BY MR. ANTONUCCI: Okay. And now as we've already discussed, you've provided a rebuttal report which modified some of the conclusions from Exhibit 6; is that right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: No, I don't believe it modified the conclusions of this report. I wouldn't state it that way.

Q. BY MR. ANTONUCCI: Okay. There were errors in Exhibit 6 that you corrected in Exhibit 7; is that correct?

A. That's correct.

Q. Okay.

A. But I don't think any of those errors were significant enough to change the opinions rendered in the initial report.
Q. I understand.
So aside from those errors, are -- is there anything else in Exhibit 6, your initial report, sitting here today that is incorrect?
A. Not that I can think of.
Q. Okay. All right. Now if you could please flip to Page 1-1 of Exhibit 7, that's the rebuttal report.
A. Sure.
Q. All right. Page 1-1 of Exhibit 7, your rebuttal report, has the heading "Summary of Opinions"; is that right?
A. Correct.
Q. And there's a list of six opinions on Page 1-1 of Exhibit 6; right?
A. Correct.
Q. Is this a complete list of all the opinions from your rebuttal report, Exhibit 7?
MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yes.
Q. BY MR. ANTONUCCI: Do you have any opinions regarding the content of ATSDR's groundwater modeling efforts at Camp Lejeune that are not contained in this list?
MS. BAUGHMAN: Objection. Form. Asked and answered.
THE WITNESS: I don't think I have any opinions that are inconsistent with this list, no.
Q. BY MR. ANTONUCCI: All right. Now, this is from the rebuttal report which includes the corrections to your initial report; is that right?
A. Say that again.
Q. We're looking at your rebuttal report right now, and this --
A. Yes.
Q. -- report includes corrections to your initial report; is that right?
A. Correct.
Q. Does any part of this report need to be corrected?
A. Not that I can think of.
Q. Is any part of this report

incorrect?

A. Not that I can think of.

Q. Is there any part of this report that needs to be updated?

A. No.

Q. You provided, I believe, three lists of materials considered in this case; is that right?

A. What are you referring to?

Q. So my understanding is that you provided a list of materials considered with your initial report, then an updated list of materials considered with that same initial report, and finally a list of materials considered with your rebuttal report; is that correct?

A. That sounds correct.

Q. Okay. Does that materials considered list include all of the facts, data, and information you considered in rendering your opinions?

A. I believe so, yes.

Q. Did you review any facts, data, or information not listed on your materials considered lists in rendering these opinions?

A. Not that I recall.
Q. Okay. Did you review any academic texts when preparing these opinions?
MS. BAUGHMAN: Objection. Form.
You mean other than what's on the lists?
Object to the form.
THE WITNESS: I don't recall.
Q. BY MR. ANTONUCCI: Are you not sure if there's an academic text you've referenced that aren't on your materials considered list --
MS. BAUGHMAN: Objection.
Q. BY MR. ANTONUCCI: -- or in your report?
A. I don't recall any other references specifically considered that were not cited in our report.
Q. Okay. Did you review any course books or peer-reviewed articles in rendering these opinions?
MS. BAUGHMAN: Object to the form.
You mean other than what's

already referenced?

THE WITNESS: I -- in the process of conducting the post-audit and writing the review, I cited -- I believe we cited all of the materials that were directly referenced as part of that process.

Now, were there other books and articles through my career that I've read that influenced this? Probably. Things we specifically cited in terms of writing this that were specifically relevant, I believe we cited those.

Q. BY MR. ANTONUCCI: Can you think of any books or articles you've read through the course of your career that may have influenced your opinions?

A. Oh, yeah, I would say I have 34 years of experience in groundwater and contaminant transport modeling, and I've read countless articles and books that form my basis of knowledge and expertise in this area.

Q. Is there any that stand out?

A. Not particularly.

Q. Okay. Have you reviewed or otherwise considered any other expert reports in this case?
A. Related to the case? I -- I've reviewed the -- several other -- I've reviewed the expert reports by Morris Maslia, Mustafa Aral, Leonard Konikow, I believe Sabatini is his name, the professor at Oklahoma.
Those are the ones I recall off the top of my head. And then of course the -- the DOJ reports that were submitted.
Q. By "the DOJ reports that were submitted," are you referring to the expert report of Dr. Spiliotopoulos?
A. Correct.
Q. And the expert report of Dr. Remy Hennet?
A. Yes.
Q. And the expert report of Dr. Jay Brigham?
A. Yes.
Q. So you reviewed all three of those?
A. Yes.

Q. You mentioned reviewing the expert report of Morris Maslia; is that correct?
A. Yes.
Q. Morris Maslia submitted two reports in this case. Did you review both of those?
A. Yes.
Q. Beginning with his initial report, that was the report disclosed October 25th of 2024. Do you agree with all of the opinions in Mr. Maslia's report?
MS. BAUGHMAN: Object to the form.
THE WITNESS: As far as I can recall.
Q. BY MR. ANTONUCCI: And with regard to Mr. Maslia's rebuttal report, that was the report disclosed January 14th of 2025. Do you agree with all of the opinions in that report?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: Yes.
Q. BY MR. ANTONUCCI: What's your

opinion of Mr. Maslia?
A. I think he's a -- a very competent and experienced expert in the field of groundwater flow and transport modeling.
Q. What's his reputation in the field of groundwater flow and transport modeling?
A. As far as I know, he's respected.
Q. Turning to the expert report of Dr. Mustafa Aral, October 25, 2024, do you agree with all of the opinions in that report?
MS. BAUGHMAN: Object. Form.
THE WITNESS: I believe so. I can't think of anything specific that I would disagree with.
Q. BY MR. ANTONUCCI: What's your opinion of Dr. Aral?
A. He's a very accomplished and widely respected expert in this field.
Q. And do you agree with all of the opinions in Dr. Sabatini's report?
MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yes.

Q. BY MR. ANTONUCCI: What is your opinion of Dr. Sabatini?

A. I don't know him very well.

Q. Do you know his reputation in the field of groundwater modeling?

A. Not independent of this project. I reviewed his resum? and his experience and it seems very impressive.

Q. And did you -- did you agree with the opinions stated in the expert report of Dr. -- Dr. Leonard Konikow?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yes.

Q. BY MR. ANTONUCCI: And what's your opinion of Dr. Konikow?

A. Well, he's -- he's one of the most widely respected experts in groundwater modeling.

Q. Okay. So would you say he has a generally good reputation in the field of groundwater modeling?

A. He has an exceptional reputation.

Q. Okay. I'd appreciate if you could turn back to Exhibit 7, and I'd like for you to look at the materials considered list that's at the end of Exhibit 7.
A. Sure.
Q. So I understand that there's a sort of intermediate materials considered list for your initial report. However, this is your rebuttal report; right?
A. Correct.
Q. Is this the final materials considered list for your rebuttal report?
A. These are the materials that we cited specifically in writing the report.
Q. Does it also include the materials you considered in review -- in rendering your opinions?
A. No, not necessarily. For example, this -- this doesn't include the -- the specific list at the back doesn't include the DOJ reports.
Q. Okay. Other than the DOJ reports, are there any other materials you considered in rendering your opinion that's not included on this list?

A. Not that I can think of.
Q. Okay. So according to this list, you considered ATSDR's Tarawa Terrace Chapters A, F, and C; is that correct?
A. Correct.
Q. Did you review any other chapters of ATSDR's Tarawa Terrace reports?
A. I skimmed through some of the others, but not in the same detail that I read Chapters A, C, and F.
Q. Do you remember which others you skimmed?
A. I don't recall.
Q. Do you remember the subject matter of the other reports that you skimmed?
A. The -- I believe it may have included a more detailed dive into the uncertainty analysis, but I -- I can't -- I couldn't specifically tell you which one. I just know I looked through the others.
Q. Okay. You remember discussion of the uncertainty analysis in the other reports. Do you remember the subject matter of any others?
A. I'm not positive on that, but I

believe that's the topic of one of the others. I -- I couldn't specifically cite the topics of the others, yes.

Q. Did you review others or just the uncertainty analysis chapter?

A. Like I say, I believe I skimmed through all of them, but -- just to see what was there, but I -- I did not do a -- as thorough a reading of those chapters as I did of A, C, and F.

Q. Okay. So you didn't thoroughly review Chapter B: Geologic Framework of the Castle-Hayne Aquifer System; correct?

A. Correct.

Q. You did not thoroughly review Chapter E: Occurrence of Contaminants in Groundwater; is that right?

A. Correct.

Q. You didn't thoroughly review Chapter G: Simulation of Three-Dimensional Multispecies Multiphase Mass Transport of Tetrachloroethylene (PCE) and Associated Degradation Byproducts; is that right?

A. Correct.

Q. You didn't closely review

Chapter H: Effective Groundwater Pumping Schedule Variation on Arrival of Tetrachloroethylene (PCE) at Water Supply Wells and Water Treatment Plants; is that correct?

A. Correct.

Q. And you didn't thoroughly consider or thoroughly review Chapter I: Parameter Sensitivity, Uncertainty, and Variability Associated With Model Simulations of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water; is that right?

A. I -- I believe I may have read that a little more carefully than the others, but certainly not to the same depth of analysis as I did to the other chapters.

Also, Chapter A is kind of a comprehensive summary, as I understand it, of all of the work that was done, including what was put in those other chapters. And so I felt like I had a reasonably good exposure to the overall methods and processes that were used and then described in more detail in those chapters.

But for the purpose of the post-audit which we were hired to do, certainly the most important chapters would be A, C, and F.

Q. Why are A, C, and F the most important chapters for the post-audit you were hired to do?

A. Because A is a -- is a comprehensive summary, a detailed summary of the entire modeling project. It was very helpful in getting an overview of all of the work that was done.

Chapter C provided a very detailed description of the construction and calibration of the MODFLOW flow model.

And Chapter F was a very detailed description of the construction and calibration, uncertainty analysis associated with the contaminant transport model.

And we were asked to, in -- in conducting the post-audit, to -- to perform simulations using both the flow and transport model. So they were clearly the most relevant chapters for our work.

Q. So you weren't asked to review

all of the Tarawa Terrace chapters?

A. They were provided to us and, you know, we -- we were -- we quickly determined which chapters would be most relevant. And it's a matter of, you know, where you focus your time and effort.

Q. Were you provided with ATSDR's reports on their water modeling efforts at Hadnot Point and Holcomb Boulevard?

A. Yes.

Q. Did you review any of those?

A. Yes.

Q. Is there a particular reason none of them are on your materials considered list?

A. Because our primary focus was Tarawa Terrace in terms of the -- what we were asked to do with the -- with the post-audit.

Q. Did you perform as close of a reading on the Hadnot Point/Holcomb Boulevard chapters as you did with Tarawa Terrace Chapters A, C, and F?

A. I wouldn't say it was as equally careful because it was less relevant,

but I did, as I recall, read the entire report on the Hadnot Point/Holcomb Boulevard report --

Q. Did you --

A. -- just to be familiar with the overall project.

Q. And you said that you read those. Did you skim through them or did you read them carefully?

A. I read them completely.

Q. Is there a reason that you skimmed through the Tarawa Terrace reports but not the Hadnot Point reports?

MS. BAUGHMAN: Objection to form.

THE WITNESS: I read through the portions of the -- carefully the Tarawa Terrace reports that I felt were most critical for the work we were asked to do.

Q. BY MR. ANTONUCCI: What about the Hadnot Point reports was critical for your Tarawa Terrace post-audit?

A. I -- I wouldn't classify it as critical. I partially read that out of

interest. Curious to -- to kind of see and compare the work that was done there versus the work that was done at Tarawa Terrace.

Q. Do you have any opinions on the Hadnot Point or Holcomb Boulevard chapters that ATSDR published?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: A general opinion that the work that was done there seemed to be rigorous and followed what I would consider good -- good practices, sound practices.

Q. BY MR. ANTONUCCI: And -- I'm sorry, go ahead.

A. I can't think of anything more specific than that, I would say.

Q. What is that opinion based on?

A. Just my reading the document and my experience and the processes they appeared to follow.

Q. Do you have any other opinions about ATSDR's Hadnot Point/Holcomb Boulevard modeling efforts other than that they were rigorous and followed good practices?

A. Not that I can think of at the moment.

Q. So you provided a post-audit for the Tarawa Terrace models; is that right?

A. Correct.

Q. You did not provide a post-audit for the Hadnot Point/Holcomb Boulevard model; is that right?

A. That's correct.

Q. Why did you not provide a post-audit for Hadnot Point or Holcomb Boulevard?

A. We were not asked to do so.

Q. Okay. Have -- are you familiar with the text Modeling Groundwater Flow and Contaminant Transport by Jacob Bear and Alexander H.-D. Cheng?

A. I've heard of it.

Q. Have you ever reviewed it?

A. Not carefully, no.

Q. Do you have any opinion on the reputation of Dr. Bear or Dr. Cheng?

A. I know Dr. Bear is a well-known, widely respected groundwater expert. I'm not as familiar with the other

author.

Q. Do you consider Modeling Groundwater Flow and Contaminant Transport to be a reliable authority in the field of groundwater modeling?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: What do you mean by "authority"?

Q. BY MR. ANTONUCCI: How would you define "authority"?

MS. BAUGHMAN: Objection. Form. He's asked you to clarify your question.

THE WITNESS: I would just say it's a -- it's a book in the field of groundwater I'm familiar with, written by a well-known groundwater expert.

Q. BY MR. ANTONUCCI: Do you consider it to be a reliable book?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I -- like I say, I -- I don't -- I haven't read it. I may have skimmed it earlier in my

career, so I -- I don't -- I'm not comfortable rendering an opinion on the book.
Q. BY MR. ANTONUCCI: Okay. Are you familiar with the text Applied Groundwater Modeling Simulation of Flow and Advective Transport by Mary Anderson, William Woessner and Randall Hunt?
A. Yes.
Q. My understanding is that there are two editions of that text; is that right?
A. That's correct.
Q. 1992 and 2015?
A. Correct.
Q. Have you reviewed both editions of that text?
A. Yes.
Q. Did you consult that text in rendering the opinions in your reports?
A. Only in the basis that those texts, along with hundreds if not thousands of other documents, have formed my general background and expertise in groundwater modeling. Not -- not specifically to the point where I would feel it needs to be

cited, that I can recall.

Q. Sure. So you consider the Anderson, Woessner, and Hunt text to be a reliable authority in the field of groundwater modeling?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I believe it's a -- a -- a valuable and informative book in the area of groundwater modeling.

Q. BY MR. ANTONUCCI: What do you mean by "valuable and informative"?

A. Meaning it has useful content that is helpful in forming understanding of groundwater modeling principles.

Q. Okay. In your experience as a professor, have you ever used that text?

A. I teach a graduate course on groundwater modeling, and I believe there were times in the past where I listed Anderson, Woessner as a -- as an optional textbook that -- but I haven't used it as a required textbook ever.

Q. Okay.

A. That I recall.
Q. Would you make an optional text -- would you list an optional text on your syllabus if it -- you considered it unreliable?
MS. BAUGHMAN: Objection. Form.
THE WITNESS: I'm not sure what you mean by "unreliable." I think it's a valuable and instructive book on the general concepts of groundwater modeling.
Q. BY MR. ANTONUCCI: Okay. Other than listing it on your syllabus as an optional text for your students, have you used it in any other capacity as a professor?
A. One of the things that -- there's a -- early in the book there's, I believe, a chapter on the groundwater modeling process, talks about forming conceptual models or the different steps in a modeling project, and if I ever refer to that text I often reference that as a -- as a good overview of the groundwater modeling process in general.

When I -- when I teach my course, I present it in a similar fashion.

Q. Okay. And that's because it's valuable, informative, and instructive; right?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: It's -- it's an instructive textbook, yes.

Q. BY MR. ANTONUCCI: Is it valuable?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I'd consider it valuable, yeah.

Q. BY MR. ANTONUCCI: Is it instructive?

A. It's instructive.

MR. ANTONUCCI: All right. I am going to mark for identification Exhibit 8.

(Exhibit 8 was marked for identification.)

Q. BY MR. ANTONUCCI: All right, Dr. Jones, do you recognize this?

A. Yes, I do.

Q. What is it?
A. These are lecture notes used in my graduate course on a Groundwater Modeling CE 547.
Q. Okay. Did you create -- it looks like this is a PowerPoint presentation; is that right?
A. Correct.
Q. Did you create this yourself?
A. I did.
Q. Okay. And is this a fair and accurate copy of your lecture notes from your graduate course in groundwater modeling?
A. It appears to be, yes.
Q. Okay. I'd like for you to turn to Page 2 and Slide 3.
A. Yes.
Q. I think this might be what you were referencing earlier with regard to the model development protocol from Anderson and Woessner; is that correct?
A. Woessner.
Q. Excuse me. Thank you.
A. Yeah.
Q. So --

A. Excuse me. Yes, this is precisely what I was discussing earlier.
Q. Okay. So you use the Anderson and Woessner text to discuss the model development protocol; is that right?
A. Yes.
Q. Okay. Did you adapt this flow chart from the Anderson and Woessner -- Woessner text?
A. Yes.
Q. Okay. And then sort of flipping through the other sections of this PowerPoint, it looks like you continue to use it throughout the lecture; is that right?
A. Well, the purpose of this lecture is to provide an overview of the model development protocol, and so the different slides here are explaining each of the different steps involved in the model development process, and thus it relates to the different items on that -- on that flow diagram.
Q. Is that a yes?
A. Yes.
Q. Okay. Are you familiar with

the text Guidelines for Evaluating Groundwater Flow Models by Thomas Reilly and Arlen Harbaugh?

A. I'm aware of that, yes.

Q. Do you consider that text to be a reliable authority in the field of groundwater modeling?

A. Again, I -- I --

MS. BAUGHMAN: Object to the form.

THE WITNESS: I think it's a helpful book.

Q. BY MR. ANTONUCCI: Okay. How about the text Calibration and Uncertainty Analysis For Complex Environmental Models by John Doherty; are you familiar with that?

A. Yes.

Q. And John Doherty is the individual who developed the PEST code; is that right?

A. That's correct.

Q. Do you consider Calibration Uncertainty Analysis For Complex Environmental Models to be a reliable authority in groundwater modeling?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I think it's a -- it's a good reference for calibration.

Q. BY MR. ANTONUCCI: Okay. And earlier you -- you mentioned working with Dr. Prabhaker Clement on a grant or some -- the project at the University of Alabama; is that right?

A. That's correct.

Q. Dr. Clement is the principal investigator of that project?

A. That's correct.

Q. What's your opinion of Dr. Clement?

A. Dr. Clement and I have worked together professionally since the earliest days of my career. I consider him a very good researcher and also a close personal friend. And he and I are also currently co-investigators on a NOAA-funded research grant.

Q. All right. I'm going to sort of refocus attention on the ATSDR reports which you were asked to provide opinions

about.

That's correct, that you were asked to provide opinions on ATSDR's Tarawa Terrace reports; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I'm not sure I would phrase it that way. We were asked to conduct a post-audit and render opinions relative to that post-audit, and -- and that involved -- I'm going to take that back.

Yes, we did render opinions on these reports.

Q. BY MR. ANTONUCCI: Okay. These reports deal with, at a very basic level, groundwater models; right?

A. What do you mean by "a very basic level"?

Q. I don't mean to say that the reports themselves are basic. I guess I should say, like, essentially they deal with groundwater models; is that correct?

A. That's correct.

Q. Okay. Groundwater models are simplified versions of reality; right?
A. That's correct.
Q. And we should never expect a groundwater model to perfectly reproduce subsurface conditions; is that correct?
MS. BAUGHMAN: Object to the form.
THE WITNESS: That's correct. I would not expect any model to perfectly replicate the real-world system that it is meant to simulate.
Q. BY MR. ANTONUCCI: Okay. If you could please turn your attention back to Exhibit 8. That's the PowerPoint.
A. Sure.
Q. I'd like you to turn to Slide 14.
A. Yes.
Q. Okay. There are two quotes on this slide; right?
A. Correct.
Q. The first one says "One of the most insidious and nefarious properties of scientific models is their tendency to take

over, and sometimes supplant, reality." That quote is attributed to Erwin Chargaff?

A. That's correct.

Q. Did I read that correctly?

A. Uh-huh.

Q. And that was quoted in J.J. Zuckerman, The Coming Renaissance of Descriptive Chemistry, Journal of Chemical Education in 1986?

THE REPORTER: In what year?

MR. ANTONUCCI: 1986.

Q. Is that correct?

A. Yes.

Q. The next quote on the page says, quote, "... all models are approximations. Essentially, all models are wrong, but some are useful." And that quote is attributed to George E.P. Box.

Did I read that correctly?

A. Correct.

Q. And that's from George E.P. Box and Norman R. Draper, Empirical Model-Building and Response Surfaces 2007; is that right?

A. Correct.

Q. This is the last slide of your lecture.

A. That's correct.

Q. Why did you choose to end your lecture with these quotes?

A. Because it's a -- it's a fun launching pad for a discussion in the class. I read these quotes and I ask the students, What do you think of these statements? If models are wrong, why are you taking this class?

And that leads to a -- typically to a very constructive discussion of what's kind of captured in Box's quote there that, yeah, you should never expect a model to be a perfect replication of reality; however, models are extremely valuable as an -- as an interpretive tool, a historical reconstruction tool, and in many cases they're the best and only tool we have.

And so, again, it's meant to stimulate a discussion where I then talk about the benefits of modeling, I talk about all the different cases in -- in groundwater management and analysis where models are

critical.
Q. You agree that all models are approximations?
A. Yes.
Q. You agree that all models are wrong?
MS. BAUGHMAN: Object to the form.
THE WITNESS: Wrong in the sense that they're all simplifications of reality. That's the context of his statement here.
Q. BY MR. ANTONUCCI: So we can't expect a model to be a perfect representation of reality; right?
A. That's correct.
Q. You can put Exhibit 8 aside now.
So I understand that you were asked to provide a post-audit of ATSDR's Tarawa Terrace groundwater flow and transport model; is that correct?
A. Correct.
Q. Were you asked to do any other evaluation of ATSDR's Tarawa Terrace flow and

transport model?

MS. BAUGHMAN: Object to the form.

THE WITNESS: What do you mean by "evaluation"?

Q. BY MR. ANTONUCCI: Did you do anything -- strike that.

Were you asked to do anything other than the post-audit?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Jeff and I were asked to perform some additional simulations using the models to -- with respect to how the model output varies as a function of retardation factor.

The -- the beginning simulation time or the -- excuse me -- the -- when the contaminants were released. And both of those, the results of that were included in Morris Maslia's rebuttal report.

In other words, we were asked to run the models and post process the

results and generate some of the graphics that Morris then relied on in his report, and then we were -- most recently we -- we did an analysis where we varied the reaction rate and determined how sensitive the model was to the reaction rate.

Q. BY MR. ANTONUCCI: Is reaction rate a synonym for biodegradation rate?

A. It includes the biodegradation rate, yeah.

Q. Are there other -- so is it correct that reaction rate and biodegradation rate are not the same thing?

A. In general, the -- the reaction rate can include any kind of decay of the contaminant. Most commonly that's a result of biodegradation.

But, you know, in the grand scope of transport modeling, for example, if you're simulating a radioactive contaminant then it would simulate the half-life and decay of the contaminant.

Q. So you performed a sensitivity analysis varying the --

A. The reaction --
Q. -- reaction rate; is that right?
A. Correct.
Q. You did not vary the biodegradation rate?
A. Well, the reaction rate is inclusive of the biodegradation rate in this case.
Q. Does it include anything else?
A. I -- I believe that's predominantly what it's meant to represent in this case.
Q. Okay. And when were you asked to perform that sensitivity analysis?
A. Couple of weeks ago, maybe.
Q. Was it more than a month ago?
A. No.
Q. Was that after you had disclosed your rebuttal report?
A. Yes.
Q. Other than the figures that you created for Mr. Maslia's rebuttal report and the sensitivity analysis that we've already discussed, were you asked to do any other

evaluation of ATSDR's Tarawa Terrace groundwater flow and transport model?

A. No.

Q. Did you review the data mining techniques that ATSDR employed to generate their groundwater flow and transport model?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I recall reading about what Morris referred -- or what was referred to as the data mining process, but I'm not sure I could recall specific details.

Q. BY MR. ANTONUCCI: So is it fair to say you didn't thoroughly evaluate the data mining process that ATSDR undertook?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I -- I reviewed what was in, I believe, Chapter A -- A, C, and F.

Q. BY MR. ANTONUCCI: Okay. Did you review the conceptual model for the Tarawa Terrace groundwater flow and transport model that ATSDR created?

A. Yes.
Q. Can you describe that review, please.
A. Well, the -- the conceptual model was described in the Chapters A, C, and F, and I reviewed it as I -- in that context.
Q. Did you undertake any other review of the conceptual model, apart from your review of the reports?
A. No.
Q. Did you note any flaws in the conceptual model?
A. I don't recall anything that stood out to me as being flawed or a bad assumption, no.
Q. Okay. If you had noted any flaws, would you have included that in your report?
A. Depending on the magnitude of the flaw, I suppose, yes.
Q. How big would a flaw have to be to be included in your report?
A. Well, one of the opinions in our report was the -- the methods that they followed were sound and followed good

scientific and engineering practices and, yeah, I just -- I did not find anything that -- that I was -- would consider to be an error in their process.

Q. If you had noted a flaw in ATSDR's conceptual model, do you believe that recalibration of the models using the post-audit data would have yielded substantive changes in ATSDR's original results?

MS. BAUGHMAN: Object to the form. Incomplete hypothetical.

THE WITNESS: Can you say that again.

Q. BY MR. ANTONUCCI: Sure.

Suppose you had noted a flaw in ATSDR's conceptual model. Do you believe that recalibration of the ATSDR models using your post-audit data would have yielded substantive changes in ATSDR's original results and conclusions?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I think their conceptual model was -- was sound and

consistent with the hydrogeologic conditions at Tarawa Terrace, and I think the model was well calibrated.

Q. BY MR. ANTONUCCI: Do you have any opinion about whether or not a -- Mr. Maslia or Dr. Aral should have reran the model using your post-audit data?

A. Yes.

Q. What is that opinion?

A. So the -- the objective of the post-audit was to take the original MODFLOW and MT3D models and evaluate the performance of the model with additional data which was not available to them at the time they built the model.

And when they built the model, they had two sets of data. They had PCE -- well, they had a large set of head and flow data that they used to build a well-calibrated flow model, which is the foundation of the transport model.

To calibrate the transport model, they had a set of PCE concentrations, I believe there were 36 at -- at different points in time at monitoring well locations.

And then they had some concentrations of water at the water -- Tarawa Terrace water treatment plant.

The objective, as I understand it, the original study was to do historical reconstruction of the concentration of the water at the water treatment plant based on the -- the migration of the plume through the Tarawa Terrace aquifer.

And when they did their calibration, the -- if you look specifically at the PCE -- measured PCE -- observed PCE concentrations at the observation wells, there was a high bias for observed concentrations in the lower range, but where there was high, observed concentrations, the simulated concentrations matched quite closely.

That's significant because that means that in the center of the plume where the concentrations are the greatest, the model did a good job predicting the concentrations.

Now, that happens to correspond to Well TT-26, which as the model showed was

the primary contributor of contaminated water to the Tarawa Terrace water treatment plant.

After they did their initial calibration --

INTERCOM SYSTEM: Hi everyone. Trina and her dog are in her office. If you want to go over there and say hi to -- to the dog and also to Trina if you want, please head over there. Thank you.

THE WITNESS: The -- they -- they -- the -- the model simulated concentrations at the water treatment plant matched the observed concentrations at the water treatment plant extremely well.

So when we did our post-audit work, we had an additional 318 measured concentrations, observed concentrations. A much richer set that they didn't have in the original case.

So -- but what we didn't have is, you know, additional concentrations at the water treatment

plant, of course, because they stopped pumping due to the contamination.

So when we did our post-audit, we found that the -- if you look at the simulated versus observed concentrations from the extended simulation we constructed in the post-audit, there's a significant amount of variance in the observed concentrations.

And that variance caused some -- some high fluctuations in the area -- in the error. However, the errors seemed to be well balanced, meaning the model did a good job at simulating the primary trajectory of the plume.

In fact, if you look at the bias, the bias we got from the extended simulation with the additional data was -- was smaller than the bias they had with the initial concentrations at the observation wells, which I believe strengthens the evidence supporting

the accuracy of the additional model.

And, therefore, I -- there's no reason for me to believe, based on the results of the post-audit, that the initial model was wrong, especially when it comes to the concentrations at the water treatment plant.

It did an excellent job and there's nothing in the post-audit that would warrant, I believe, that would be strong evidence to say, hey, there's something wrong with the original model.

Q. BY MR. ANTONUCCI: Well, thank you, Dr. Jones, I appreciate that. But my question was whether they should have reran the model using the newly available data?

MS. BAUGHMAN: Object to the form. Asked and answered.

THE WITNESS: We did rerun the model. That's part of the -- that's what we did in the post-audit, is we ran the model.

Are you asking me if they should have recalibrated it or if they

should have rerun the model?

Q. BY MR. ANTONUCCI: Should they have recalibrate the model using newly available data?

A. We -- well, before you recalibrate it, you would do an analysis precisely in the fashion that we did. You would test the original model using the new data.

And if in that process there was some evidence that there was a major flaw with the original model or that you would get significantly different answer, then that may warrant a reevaluation. But we did not find any evidence to that.

MR. ANTONUCCI: Okay. I'd like to clarify for the record. In my previous question I used the term "they." I was referring to Morris Maslia and Dr. Aral and their expert reports.

All right. I would -- I would like to discuss a new document, so I am going to mark for identification Exhibit 9.

(Exhibit 9 was marked for identification.)

Q. BY MR. ANTONUCCI: All right. Dr. Jones, Exhibit 9 is the document titled "Analyses of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water at Tarawa Terrace and Vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina: Historical Reconstruction and Present-Day Conditions Chapter A: Summary of Findings."

And for the record, this document has the Bates range beginning CLJA_WATERMODELING_09-0000615638 and ends with the Bates number ending in 615753.

And when I say "Bates number," Dr. Jones, do you know what I'm referring to?

A. My understanding is it's a -- it's a systematic way of referring to content that's been submitted in litigation.

Q. Right. It's the numbers at the bottom; right?

A. Right.

Q. Okay. So I would appreciate if you could turn to Page A48 of Exhibit 9, and that page ends in Bates Number 615699.

Okay. So the caption underneath the figure on Page A48 says "Figure A21. Sensitivity of tetrachloroethylene concentration in finished water at the water treatment plant to variation in water-supply well operations, Tarawa Terrace, U.S. Marine Corps Base Camp Lejeune, North Carolina. [PCE, tetrachloroethylene; see text for discussion of points A-I]."

You're familiar with this figure; right, Dr. Jones?

A. Yeah, I've seen it before.

Q. This is one of the figures you had tabbed in your copy of the report; right?

A. No, it was not.

Q. Okay. Well, this is a graph from ATSDR's sensitivity analysis of the Tarawa Terrace model; isn't that right?

A. Correct.

Q. And this shows the change in PCE concentrations in finished water based on different well pumping schedules; is that right?

A. Correct.

Q. And, Dr. Jones, you're aware that ATSDR used the pumping and schedule optimization system tool to simulate otherwise unknown supply well pumping rates; right?

A. Yes.

Q. And in this graph, all of the simulations assumed a constant mass loading rate of 1,200 grams per day; is that right?

A. Yes, I assume so.

Q. And that constant rate of 1,200 grams per day is the same mass loading rate that you used when conducting the post-audit; right?

A. Correct, we did not change the model.

Q. Okay. So looking at Figure A21 on Page A48 of Exhibit 9, we see that all of these use a mass loading start date of January 1953; is that correct?

A. Where are you reading that?

Q. Strike that.

All of the -- ATSDR's model assumed a PCE mass loading start date of January 1953; is that right?

A. As far as I know, yes.
Q. Okay. And that's the same mass loading start date that you used in your post-audit?
A. Correct.
Q. Okay. So on Figure A21, that blue line that's -- it's labeled A.
Do you see that?
A. Yes.
Q. This blue line shows the earliest arrival of PCE at the water treatment plant under the maximum pumping schedule; right?
A. Correct.
Q. Okay. And so that blue line shows a concentration of 0.001 micrograms per liter of PCE starting just before January 1955; is that right?
A. That looks correct, yes.
Q. Okay. Now, there's also a red line here, and that one is labeled B.
Do you see that?
A. Yes.
Q. And that is the calibrated model; right?

A. Correct.
Q. Okay. That's the same -- that model used the same parameters that you used in your post-audit; is that right?
A. Yes.
Q. So that red line, the calibrated model, shows a concentration of 0.001 micrograms per liter of PCE starting on or about January 1955; right?
A. Correct.
Q. Okay. Next I'd ask that you look at the black line. That one is labeled C.
A. Yes.
Q. So this shows the late arrival of PCE at the water treatment plant under the Minimum Schedule Number 2; is that right?
A. That looks correct.
Q. Okay. And under the Minimum Schedule 2, TT-26 is operated at at least 25 percent capacity; right?
A. Yes.
Q. And that black line that's line -- letter C shows a concentration of 0.001 micrograms per liter of PCE starting

sometime after January 1955; right?

A. Yes.

Q. All right. Now, finally there's the green line, and that one is, I believe, split into D and G.

Do you see what I'm referring to?

A. Yes -- well, let's see. The black -- oh, yes, the -- Well TT-26 not operated January '62 to February 1976, hence there's a gap, yes.

Q. Okay. So that green line, that shows the arrival -- excuse me -- it shows the latest arrival of PCE at the water treatment plant under Minimum Schedule 1; right?

A. That's -- that looks correct, yeah.

Q. Okay. And minimum -- Minimum Schedule 1 is where Well TT-26 is not operated between January of 1962 and February of 1976?

A. That's correct.

Q. Okay. So that green line shows a concentration above 0.001 micrograms per

liter of PCE starting sometime between January 1955 and January of 1960; right?

A. Starting, yes.

Q. Okay. And then there's sort of a gap where the green line is not represented on the figure, and then it restarts again sometime between January 1970 and January 1975; is that right?

A. Yes.

Q. Okay. So in general, that blue line, that shows the highest PCE concentrations over time; right?

A. Yes.

Q. Then that red line there, that shows the next highest PCE concentrations over time; right?

A. Yes.

Q. Then the black line shows the next highest PCE concentrations over time?

A. Yeah, I think that's fair.

Q. Okay. And, finally, that green line shows the lowest PCE concentrations over time; right?

A. Correct.

Q. Okay. So the arrival of PCE at

the water treatment plant is dependent on when PCE contamination arrived at the supply wells; right?

A. Can you say that again.

Q. Of course.

The arrival of PCE at the water treatment plant is dependent on when PCE contamination arrived at the supply wells; right?

A. Correct.

Q. The concentration of PCE simulated by the model is dependent on when PCE contamination arrived at the supply wells; right?

A. The concentration at the treatment plant. You said -- I'm sorry, can you state that one more time.

Q. Of course.

The concentration of PCE simulated by the model is dependent on when PCE contamination arrived at the supply wells; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Yeah, I -- I

think you're not clear in how you formulated that question. Do you mean the concentration at the water treatment plant?

Q. BY MR. ANTONUCCI: As opposed to?

A. You just said "the concentration."

Q. Sure. Yes. Let's say -- I'll rephrase the question.

A. Okay.

Q. The concentration of PCE simulated by the model at the water treatment plant is dependent on when PCE contamination arrived at the supply wells; right?

A. Correct.

Q. Okay. And to be clear, the contamination at the water treatment plant was assumed to be the same level at the tap in consumer's homes; right?

A. Would you state that again.

Q. Sure.

The ATSDR assumed that contaminations of PCE at the water treatment plant were the same as those after the water

had gone through the water distribution system and was at the point of use by the consumer; is that right?

A. Yeah, I'm not sure on that.

Q. Do you know if -- I mean, should there be a different contamination concentration at the water treatment plant versus at the tap?

A. I know that one of the areas that's been debated in the -- in the rebuttals and the expert report is how much the concentration changes through the water treatment process, and I know that was reviewed by the expert panel and others.

I'm generally familiar with that discussion that that volatilization issue was addressed by Sabatini. That is not my area of expertise.

I will say that what the model simulates is the water that would be pumped, the concentration of the water as it's pumped out of the aquifer, that's what -- the model does not inherently explicitly include the treatment process as part of the model.

Q. Okay.

A. It's simply how the contaminants move through the aquifer through the wells.

Q. Do you agree that there would be losses of contamination to volatilization during the treatment process?

MS. BAUGHMAN: Object to the form.

THE WITNESS: That is not my area of expertise.

Q. BY MR. ANTONUCCI: Okay. However, the model -- the model doesn't take that into account --

MS. BAUGHMAN: Object to the form.

Q. BY MR. ANTONUCCI: -- correct?

A. The model does not explicitly simulate volatilization.

Q. Does the model implicitly simulate volatilization?

A. It potentially could.

Q. Can you please elaborate.

A. Sure. Suppose that the concentrations used to calibrate the model were concentrations taken from treated water.

If the model is then calibrated to predict accurate concentrations at the water treatment plant based on observed concentrations of treated water, then you could argue that it implicitly includes the effects of any volatilization.

Q. Did the model calibrate to treated water samples?

A. I know some of the samples -- from what I've read, it's believed some of the samples may have been post-treated water, and -- but I don't know if there's any conclusion on the majority of the samples.

Q. Okay. Well, it's fair to say that concentrations of PCE at the water treatment plant that's simulated by the model is dependent on when PCE contamination began entering the aquifer; right?

A. Yeah.

Q. Based on your review of the reports, is it your understanding that ATSDR assumed PCE contaminants started leaking when ABC Cleaner started operating in 1953?

A. Yes.

Q. Hypothetically, if ABC Cleaners

opened later than 1953, would that impact the arrival time of contaminants at the water treatment well?

A. It would --

MS. BAUGHMAN: Object to the form. Incomplete hypothetical.

Go ahead.

THE WITNESS: It makes a small difference in the concentrations at the water treatment plant.

Q. BY MR. ANTONUCCI: Okay. So let's say that the --

MS. BAUGHMAN: Were you finished answering?

THE WITNESS: Let me clarify.

I know some different dates have been proposed, argued by the DOJ experts as a more accurate start date.

Having run the model at both start dates, I -- I believe that the differing start dates as proposed by the DOJ experts does not make a substantial difference in the concentrations that are simulated at the water treatment plant.

Q. BY MR. ANTONUCCI: Okay. So it doesn't make a substantial difference; right?
A. No, that was part of Morris Maslia's rebuttal report.
Q. Is that a yes?
A. Yes.
Q. Okay. Does it make any difference?
A. It makes some difference.
Q. Okay. Hypothetically, let's ignore the start dates proposed by differing experts.
A. Okay.
Q. Let's say that the contamination began in 1970. How big of a difference would that make?
MS. BAUGHMAN: Object to the form.
THE WITNESS: If the contamination started in 1970 --
Q. BY MR. ANTONUCCI: Let's say -- what would the impact on 1981 data be?
MS. BAUGHMAN: Object to the form. Are you asking in terms -- wait, in 1981?

Are you asking in terms of the concentration or the arrival time? I object to the form. I don't understand the question.

THE WITNESS: So if --

MS. BAUGHMAN: It's also outside the scope.

THE WITNESS: If the contamination was not released until 1970, and that was simulated in the model, yeah, I would suspect that would lead to a much more significant difference in the results.

Q. BY MR. ANTONUCCI: Okay. If you were to -- to dispose of dry cleaning solvents improperly -- which I know you never would -- they would be -- you would -- let's assume you would dump them on the ground.

Do you understand where my hypothetical is so far?

A. Okay, yeah, sure.

Q. If you were to just pour dry cleaning solvents on the ground outside, would the PCE from that solvent enter the aquifer immediately?

MS. BAUGHMAN: Object to the form. Incomplete hypothetical. Foundation.

THE WITNESS: Immediately, no.

Q. BY MR. ANTONUCCI: Okay. Can you elaborate?

A. Well, if you -- for example, if you had a really high water table, the water table's close to the surface, it would enter it very rapidly. Or if you had highly permeable materials between the ground surface and the aquifer, that contamination, again, could happen very rapidly, so it's -- depends on the context.

Q. Sure. I guess is the inverse true? If you had a low water table or low permeability materials?

MS. BAUGHMAN: Object to the form.

THE WITNESS: There are conditions where it would take longer to get to the groundwater, yes, if it's starting at the ground surface.

Q. BY MR. ANTONUCCI: Okay. So from the ground surface to the aquifer it has

to travel through something; right?

A. Yeah.

Q. And that takes time, depending on different conditions; right?

A. Yeah, another factor is the precipitation. How -- and snow melt, precipitation, how much water is -- is traveling through -- we call that the vadose zone between the ground surface and the water table.

And, you know, there are conditions that are a variety of conditions that would impact the -- the -- the rate of transport from the ground surface to the aquifer.

Q. Okay. Does MT3DMS model contaminant transport through the vadose zone?

A. No.

Q. Does TechFlowMP?

A. I believe it does, yes.

Q. And then for my own understanding, the vadose zone and the unsaturated zone, are those the same concept?

A. Yeah, same thing.

Q. If -- if the DOJ experts are correct, would you agree that it makes a substantial difference for calculating exposure to someone at Tarawa Terrace prior to DOJ's start but after ATSDR's mass loading start?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I don't understand the question.

Q. BY MR. ANTONUCCI: Not sure I do either.

So say the true start date of contaminant mass loading at Tarawa Terrace is sometime between when ATSDR said it started and when DOJ said it started.

You on board?

A. So January '53 is when ATSDR said it started. To my understanding the DOJ said maybe June '54 or July '54? Does that sound right?

Q. Sounds about right.

A. Okay.

Q. Sometime in between there.

A. Okay.

Q. If that was when mass loading started, would it make a substantial difference for calculating exposure for someone who was at Tarawa Terrace?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Your question is not -- you said "if that is when." We just talked about two different dates or -- can you restate the question?

Q. BY MR. ANTONUCCI: Sure.

Let's say contaminant mass loading started in December 1953. Would --

A. One year later, roughly, yeah.

Q. Would that make a substantial difference for calculating exposure to someone at Tarawa Terrace?

MS. BAUGHMAN: Object to the form.

THE WITNESS: No, I think one of the dates that we simulated may have been January 1954, which is one month off from that, and kind of between the January '53 and July '54 dates and, no, none of those changes

in the date made a substantial difference in the concentration of the water at Well TT-26 or in the concentration of the water at the Tarawa Terrace water treatment plant over the majority of the time frame.

Q. BY MR. ANTONUCCI: Okay. How far apart were the simulated concentrations from this experiment that you did for Mr. Maslia's report?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Well, if -- if you have the copy of the Maslia rebuttal I could -- we could look at the graph.

MR. ANTONUCCI: Okay.

THE WITNESS: It -- in my opinion, there -- there was a minor difference through a majority of the simulation period.

Q. BY MR. ANTONUCCI: Were there major differences at any time in the simulation period?

MS. BAUGHMAN: Object to the

form.

THE WITNESS: Not that I would consider significant. There was -- if you -- during the very early years, there was maybe a larger gap between the curves, but that is where the concentrations are really low.

And once the -- you get a few years later where the concentrations are higher, those curves -- the distance between those curves narrowed significantly and through most of the period from, you know, '60s, '70s, through the '80s, there's very little difference.

Q. BY MR. ANTONUCCI: Do you recall the magnitude of the difference at any time?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Numerical magnitude, no.

Q. BY MR. ANTONUCCI: What numerical magnitude would you consider significant?

MS. BAUGHMAN: Object to the form.

THE WITNESS: That depends on the context.

Q. BY MR. ANTONUCCI: What -- what numerical difference would you consider minor?

A. Depends on the context.

Q. What would impact your consideration there?

A. Well, for example, in this case for the majority of the range the -- the concentrations are at a very high rate well over the MCL level of five.

And qualitatively looking at that, it seemed like the model was highly insensitive or relatively insensitive to the -- to the start date given the start dates that were considered.

Q. Okay. And earlier you mentioned that the model is perhaps better at calculating concentrations at TT-26 than over the wider area. Am I -- is that correct?

MS. BAUGHMAN: Object to the form.

THE WITNESS: That's not how I would characterize what I said.

Q. BY MR. ANTONUCCI: Can you please repeat it for me.

A. Sure.

MS. BAUGHMAN: Object to the form.

What's the question? I don't -- let's make sure there's a question.

THE WITNESS: Do you want me to restate what I said earlier relative to simulated concentrations at observation wells versus -- sure.

As I mentioned earlier, I believe the concentration data used to calibrate and evaluate the performance of the original flow and transport model consisted of two types of data.

One of which was PCE concentrations that were sampled at observation wells; and the other is a -- was a series of measured concentrations at the water treatment plant.

When you have an individual sample taken at an observation well, it's a small amount of water from a very small part of the aquifer, a specific point location, and -- and it has -- it's more susceptible to sampling errors and -- and the impact of local scale heterogeneities.

And when they -- when they calibrated to that, they had a good match where the simulated observed concentrations were high, and a bias where the observed concentrations were low.

The concentrations that were measured -- or that were observed at the water treatment plant are different because that involves the collection of water from a variety of wells over a period of time, and the water pumped through those wells comes from a -- a much broader part of the aquifer than when you take a simple sample.

And those -- the contaminant is

then brought in and it's mixed and averaged. And so it has much less variation and sampling error than you'd get with the individual error.

So I would consider that to be, I would say, the gold standard of -- of data for calibrating the original model. And it matched, in my opinion, the model-simulated results matched those observed concentrations at the water treatment plant quite well.

Q. BY MR. ANTONUCCI: Okay. Before this deposition began, when speaking to counsel, you used the phrase "dilution is the solution to pollution"; right?

A. Yeah.

Q. That's kind of what we're talking about here, isn't it?

MS. BAUGHMAN: Object to the form.

Q. BY MR. ANTONUCCI: There were multiple wells, some were presumably pumping clean water, some were presumably pumping contaminated water, mixing and diluting at the water treatment plant; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Yeah -- well, the context are a little different. We were talking about dirty air being blown out of the valley.

But when you calculate the -- the concentration of water at the water treatment plant, you have to consider the -- the pumping rate for each of the supply wells to the water treatment plant, and then the concentration of the water coming in.

So there's a mixing process that's represented in the equation we use to come up with those concentrations.

It weights the -- the overall concentration by the product of the individual concentrations and the individual pumping rates.

So there's a mixing and, yeah, there's a dilution process. For example, the -- the water coming in in Well TT-26 has a higher concentration

than the water you measure at the water treatment plant because it's mixed with water from other supply wells that have generally a lower concentration.

Q. BY MR. ANTONUCCI: Okay. So -- all right. Thank you for answering that.

If you could turn to Page A2 of Exhibit 9. I think this will maybe tie up what we were discussing earlier. And that is the page ending in Bates Number 615653.

So the footnote on this page, Footnote 6 says "For this study, finished drinking water is defined as groundwater that has undergone treatment at a water treatment plant and is delivered to a person's home. The concentration of contaminants in treated water at the water treatment plant is considered the same as the concentrations in the water delivered to a person's home. This assumption is tested and verified in the Chapter J report (Sautner et al. in press 2007). Hereinafter, the term 'finished water' will be used."

Did I read that correctly?

A. Yes.

Q. So I will represent to you that Chapter J was never published. However, a draft of Chapter J was produced in this litigation with the Bates Number CLJA_WATERMODELING_05-22 -- excuse me -- 212246 through 212309.

Have you reviewed the draft of Chapter J?

A. No.

Q. Do you know whether any testing was done to compare the concentrations of contaminants delivered to the water treatment system with the concentrations of contaminants delivered to a person's home?

A. Not that I'm aware of.

Q. Okay. Please turn to Page A13 of Exhibit 9. That's the page ending in Bates Number 615664.

A. Got it.

Q. Okay. So there's a sort of list of paragraphs on this page. One of them starts with the Number 4.

Do you see that?

A. Yes.

Q. So this says "The monthly concentrations of PCE assigned to finished water at the Tarawa Terrace WTP were determined using a materials mass balance model (simple mixing) to compute the flow-weighted average concentration of PCE. The model is based on the principles of continuity and conservation of mass (Masters 1998).

Did I read that correctly?

A. Yes.

Q. Do you know what a materials mass balance model is?

A. I know what they're describing here, yes.

Q. So you agree that simple mixing flow-weighted average has no calculation simulating processes where contaminants are lost during storage, treatment, or distribution?

A. That's correct. It's simply taking the -- the pumping rates and concentrations of the supply wells to determine what the resulting concentration of the mixed water would be at the water

treatment plant.

Q. So a simple mixing flow-weighted average wouldn't explicitly take into account something like sorption or volatilization?

MS. BAUGHMAN: Object to the form.

THE WITNESS: That's not what it's meant to do, no.

Q. BY MR. ANTONUCCI: It's true that ATSDR's Tarawa Terrace model did not include a calculation simulating contaminant losses during storage, treatment, or distribution; right?

A. Not that I'm aware of.

Q. You agree that ATSDR's Tarawa Terrace model simulated PCE concentrations as equivalent to the mixture of water straight out of the wells?

A. Yes.

Q. And ATSDR assumed continuity and conservation of mass in its simple mixing model; right?

A. Yes.

Q. Do you agree that some losses

during treatment, storage, and distribution are inevitable?

MS. BAUGHMAN: Object to the form. Outside the scope.

THE WITNESS: That is not my area of expertise. I don't have an opinion on that.

MR. ANTONUCCI: Okay. I'd like to break for lunch now.

THE WITNESS: Great.

THE VIDEOGRAPHER: We're off the record. The time is 12:10.

(The lunch break was taken from 12:10 p.m. until 1:13 p.m.)

THE VIDEOGRAPHER: We're back on the record. The time is 1:13. This is Media Number 3.

Counsel may proceed.

Q. BY MR. ANTONUCCI: All right. Dr. Jones, I remind you that you are still under oath.

Have you discussed the substance of your testimony with anyone during the break?

A. Only superficially.

Q. Can you describe what you mean by that, please.
A. Hey, Norm, you're doing a good job.
Q. Okay. Did you discuss it -- did you discuss it any further?
A. No.
Q. All right. A couple of things I want to circle back on from before the break. First is going to be this document, which I will mark as Exhibit 10.
(Exhibit 10 was marked for identification.)
THE WITNESS: Okay.
Q. BY MR. ANTONUCCI: All right. Dr. Jones, do you know what this is?
A. Yes.
Q. What is it?
A. It appears to be the model simulation results based on varying the reaction coefficient over three different values, and it shows the resulting concentrations at the water treatment plant and at Well TT-26.
Q. Okay. What are the three different values that you used to perform

this analysis?

A. One of which was the -- the -- the middle line. The red line is the .005, which was what was used in the original ATSDR model. And one of those, as I understand, was a .004 value that was suggested or used by Faye. And then another one was a .006 value, which was suggested by -- by Dr. Aral.

Q. Okay. And for all of those values, those are different values of reaction rates; is that right?

A. Yeah, so the only thing that was changed in the model was the reaction rate, and then we looked at what impact that had on the simulated concentrations for these two outputs.

Q. Okay. And when did you perform this analysis?

A. A week or two ago.

Q. Okay. So there are two graphs here. I want to make sure we're looking at the same one. There's one that has a caption that says "MT3DMS," "Calibrated," and "TechFlowMP" in the top right. Then there's one that has the sort of legend in the middle

of the page; is that right?

A. Top left, yeah.

Q. Excuse me, thank you.

A. Yep.

Q. So what you just described, was that the version of the document with the legend in the center of the page or the left?

A. So the one with the legend in the center is the simulated concentrations at the Tarawa Terrace water treatment plant, and the one with the legend in the upper left corner is the simulated concentrations at Well TT-26.

Q. Understood.

And are the reaction rates the same for the different categories in both graphs?

A. Yes. Yeah, they're both based on the same model results, yeah.

Q. And then you also in front of you should have a series of spreadsheets.

Do you see those?

A. Yes.

Q. What -- what do these show?

A. So the first column are the

monthly dates through the simulation period, and then for each month the second column would be the -- the concentrations at -- resulting from -- well, let me back up a little bit.

This -- I believe this spreadsheet represents the concentrations at the water treatment plant.

Q. Dr. Jones, when you say "this spreadsheet," are you referring to the one with the Bates number ending in 302 or document name ending in 302 up at the top?

A. 299.

Q. 299, okay.

All right. I'm on the Page 1 of the spreadsheet with the title CL_PLJ-EXPERT_DAVIS_0000000299.xlsx. Is that where you are?

A. Yes.

Q. And this is what you were describing in your last answer?

A. Yeah, so the first column or the simulated concentrations resulting from -- or excuse me -- the first column after the date it says r00004_orig, that

would be the concentrations resulting from the simulation featuring a reaction rate of .004.

Likewise, the next column would be the results featuring a reaction rate labeled as -- or corresponding to .0005. And the last column would be the results with a simulation with a reaction rate of .0006.

In other words, it's the actual numbers used to generate the plots.

Q. Okay. I will ask you to take a look through CL_PLJ-PLG-EXPERT_DAVIS_299 and ask if you're familiar with the data contained in this spreadsheet?

A. Yes, I am. I generated it.

Q. Okay. I'm interested in the difference between the values in the three columns, the Robert Faye column, the ATSDR column, and the Dr. Aral column.

If I refer to them that way, do you understand what I mean?

A. Yeah.

Q. Okay. What -- where is the smallest discrepancy between the three data points? At what time?

A. The beginning.
Q. Okay. Is that because they all simulate a concentration of 0 micrograms per liter?
A. That's partly why.
Q. Okay. Where is the largest discrepancy between any two columns on this spreadsheet?
A. On the spreadsheet, I -- I'm not sure. If I had the spreadsheet in front of me I could use an Excel function to find that, but looking at the graphs, it appears that the -- the -- the spread between the curves increases until roughly late '60s and then it stays relatively constant after that in terms of the log-log plot.
Overall, they're -- in my opinion, they're really close. In terms of a model result, this is what I would call the models being highly insensitive to changes in the reaction rate.
Q. Did you just use the phrase "log-log plot"?
A. A log plot. So that means the vertical axis is based on the log of the

concentrations.

Q. Okay. And both of these graphs use a logarithmic scale for the Y axis; is that right?

A. That's correct.

Q. You I think stated that the concentrations, the spread between the concentrations seems to stabilize around the late '60s; is that what you said?

A. Well, there's -- there's actually a reason for that.

Q. Okay.

A. Well, there's a reason why the curves are closer together in the early years, and that's because, for example, the TT-26 plot, this is the model simulated concentrations at Well TT-26, and the source of the contaminants at the ABC Cleaners is some distance away from Well TT-26.

And so it takes time for the results to get down that far. And it's -- you're looking at -- there is a -- an early arrival, but it's at a really small concentration as a function of the dispersion coefficients used in the model.

So just the fact -- and then the Tarawa Terrace water treatment plant concentrations, those are a function of supply wells which are all downgradient.

The point being, it takes time for the contaminants to reach those wells after it leaves the source and, therefore, there's not much spread.

And you can see the same narrowing of the band in the -- in the probabilistic -- or excuse me -- the uncertainty analysis results, which is results from the same phenomenon I'm describing.

Q. Okay. If you could please turn to Page 5 of that same spreadsheet, which has the title ending in 299.xlsx. I'm just sort of looking at the bottom row. The date is February 1, 1967.

Do you see that?

A. Yeah.

Q. So it looks like under the point I think 004 reaction rate, the PCE concentration in micrograms per liter is 67.16, and then many further digits; is that

right?

A. Correct.

Q. Okay. And for the ATSDR value, that's the 0.005, it's 60.37; is that right?

A. Correct.

Q. And for the Aral value, and that's the .006, it's 54.3; right?

A. Correct.

Q. By my math, that's a -- in terms of percentages, it's a pretty widespread, don't you think?

MS. BAUGHMAN: Object to the form.

THE WITNESS: In terms of contaminant concentrations which are log normally distributed, I would consider that a relatively small chance spread of values.

Q. BY MR. ANTONUCCI: Okay. What do you mean by contaminant concentrations are log normally distributed?

A. Sure. That means there's a -- a statistical analysis you can run on data. When a parameter is log normally distributed means the values cover a very broad range of

values over several orders of magnitude.

And if you refer to the rebuttal report, Exhibit 7, this is where I can -- let's see. Give me a second to find the page I'm looking at.

MS. BAUGHMAN: You can use these, too, if that helps.

THE WITNESS: Okay, I got it right -- okay. Figure 3 of the rebuttal report. In this case I took the 318 observed PCE concentrations and ran a statistical analysis to generate a histogram. And if a parameter is log normally distributed, you see that classic bell-shaped curve.

And so this clearly indicates that the PCE values are log normally distributed, which is very typical of concentration data, and, therefore -- that's one of the reasons why people almost always show when they plot concentration data, use a log scale for the concentrations.

Q. BY MR. ANTONUCCI: When you

plot concentrations on a logarithmic scale like you've done here --

A. Yeah.

Q. -- numbers that are -- what's the benefit of using a logarithmic scale? Can you explain that to me?

A. It captures -- given that there's a high variability in concentration data and the fact that they are log normally distributed, it is considered to be the proper way to -- to show them.

And so, yeah, it will -- it also allows you to -- one of the benefits is it doesn't compress the lower part of the plot. So it allows you to get a level of detail on the very small concentrations that you wouldn't get in a -- in a -- in a non -- in a normal arithmetic scale.

Q. At the higher concentrations, would the lines be further apart if you had used an arithmetic scale here?

A. Yes.

MR. ANTONUCCI: All right. I'm going to ask that you please mark Exhibit 11 for identification.

(Exhibit 11 was marked for identification.)

Q. BY MR. ANTONUCCI: Okay. Dr. Jones, this is ATSDR's Analyses of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water at Tarawa Terrace and Vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina: Historical Reconstruction and Present-Day Conditions Chapter F: Simulation of Fate and Transport of Tetrachloroethylene (PCE).

Have you seen this before?

A. Yes.

Q. And for the record, this document has the Bates range CLJA_WATERMODELING_01-0000093047 through 93114.

Dr. Jones, could you please turn to Page F28 of this report. That's the page with Bates number ending in 93086.

A. Sure.

Q. Thanks very much.

All right. So I am reading on the last full paragraph of Page F28. This says "The PCE concentrations at water-supply Well TT-26 on September 25, 1985, and

July 11, 1991, were 1,100 and 350 micrograms per liter, respectively, and the elapsed time was 2,151 days (Table F2). Applying these data to Equation 3 yields a degradation rate of 0.00053 per day. Potentiometric levels shown on Figure F7 and F8 indicate that Well TT-26 is located on a direct advective pathway from ABC One-Hour Cleaners. Thus, PCE mass migrates downgradient toward and away from Well TT-26. To the extent migration of PCE mass toward and away from Well TT-26 occurred at about equal rates from 1985 to 1991, the compound degradation rate of 0.00053 per day approximates a long-term average degradation rate. On the other hand, if a significant quantity of the PCE degraded in the vicinity of Well TT-26 was replaced by advection, then a degradation rate computed using Equation 3 is probably a minimum rate.

"Half-lives of PCE reported in the literature range from about 360 to 720 days (Lucius and others 1990). Applying these half-lives to Equation 3 yields first-order degradation rates ranging between .001 and .002 per day, about twice to four

times the rate computed using concentrations at water-supply Well TT-26. An initial first-order degradation rate of 0.00053 per day was applied to the MT3DMS model uniformly to every layer for all stress periods. The final calibrated degradation rate was 0.00050 per day, similarly applied."

Did I read that correctly?

A. Yes.

Q. So it seems that Robert Faye, the author of this report, is saying that a higher degradation rate here could be warranted; is that right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: It looks to me like he's -- if that's who wrote this, explaining the logic that was used to calculate the degradation rate that was used in the model, .0005.

Q. BY MR. ANTONUCCI: Is there a reason that you did not calculate -- or perform sensitivity analysis using the values from this portion of Chapter F?

MS. BAUGHMAN: Object to the

form.

THE WITNESS: We were asked to perform an evaluation using the three values specified.

Q. BY MR. ANTONUCCI: Who asked you to do that?

A. The legal team.

Q. All right. You can put that to the side. Thanks, Dr. Jones.

All right. Dr. Jones, did you review the model parameters that ATSDR subjected to probabilistic analysis?

A. Yes, I read a summary of their probabilistic analysis. I'm not sure I remember all the details, but I did review that.

Q. Beyond reading the summary, did you -- beyond reading the summary, did you otherwise evaluate the model parameters ATSDR subjected to probabilistic analysis?

MS. BAUGHMAN: Object to the form.

THE WITNESS: No.

Q. BY MR. ANTONUCCI: You used all the same model parameters in your post-audit

that ATSDR used in the calibrated model; is that right?

A. Correct.

Q. Did you perform any independent evaluation of the appropriateness of those parameters?

A. No.

Q. Okay. Dr. Jones, are you aware of any critiques of ATSDR's Tarawa Terrace model?

A. Yes.

Q. Okay. Well, first, which critiques are -- are you aware of?

A. The critiques first and foremost by the Department of Justice experts we reviewed earlier.

Q. Are you aware of any other critiques of ATSDR's Tarawa Terrace model?

A. I know that there was a review by an NRC panel. There was a review by a -- a peer review by a panel of experts. I'm not sure I would call those critiques, but they're reviews. And I'm aware of -- of a paper published by Prabhaker Clement in The Groundwater Journal.

Q. Are you familiar with critiques that the Department of the Navy has made of ATSDR's Tarawa Terrace model?
A. Yes, I've seen reference to those as well.
Q. Okay. Are you aware of any other critiques of ATSDR's Tarawa Terrace model?
A. Not that I can think of at the moment.
MR. ANTONUCCI: All right. I am going to mark for exhibit -- for identification Exhibit 12.
(Exhibit 12 was marked for identification.)
Q. BY MR. ANTONUCCI: For the record, this document has the Bates range CLJA_HEALTHEFFECTS-0000000479 through 517.
Can you look up at me, Dr. Jones, after you've finished looking through that.
A. Sure.
MS. BAUGHMAN: Did you want him to read it or just flip through it?
Q. BY MR. ANTONUCCI: Dr. Jones, you've mentioned you're aware of the NRC

critique of -- or the NRC's review of the Camp Lejeune modeling done by ATSDR; is that right?

A. That's correct.

Q. Have you read this before?

A. I have skimmed through it, and I can't say I've read every part of it, no.

Q. You cited to this in your rebuttal report, didn't you?

A. Yes.

Q. How did you decide which portions to read carefully and which portions to skim?

A. I -- there were in the -- I remember reading in the documents somewhere a rebuttal to this from Morris Maslia, and so I -- I read -- I was aware with -- of some of the concepts in -- in this document and in the rebuttal.

And in the context of the -- of the post-audit that we did, there were some sections that seemed relevant to things we were discussing.

Q. Okay. Dr. Jones, you agree that the basis used for setting the values of

calibration targets was unclear for ATSDR's TT model?

A. Yes.

Q. I ask that you turn to Page 49 of the Exhibit 12.

A. Okay.

Q. I am looking at the one, two, three, fourth bullet point from the top.

Do you see that? The sentence starting with "The PSOpS."

A. Uh-huh.

Q. This says "The PSOpS modeling study is based on the premise that an optimization model can be used to evaluate pumping stresses. Without site-specific pumping data and water-quality data, the results will be nonunique and uncertain."

Did I read that correctly?

A. Yes.

Q. That's a correct statement, isn't it?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I'm not familiar enough with the context to say with

certainty whether that's a correct statement or not.

Q. BY MR. ANTONUCCI: Okay. Is this one of the sections that you skimmed or one of the sections you reviewed carefully?

A. I don't -- I don't recall reading this specific bullet point.

Q. Okay. On the next bullet point down the last sentence says "The difference indicates that the real system is highly transient and that the model did not account for temporal and spatial averaging effects."

That's a correct statement, Dr. Jones, isn't it?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I'm not willing to say whether or not that's correct or not.

Q. BY MR. ANTONUCCI: Why not?

A. You just read one sentence at the end of a paragraph, so I'm --

Q. Okay.

A. Asking me whether to say whether it's true or not, I would need to

explore the full context of what they're describing before I could have an opinion as to whether or not that's a true statement.

Q. Sure. I'll start from the beginning of that bullet point there. That's the fifth from the top.

It says "Review of water quality monitoring data indicates substantial temporal variability even at a single well."

You agree with that statement, don't you, Dr. Jones?

A. Yes.

Q. Okay. "For example, the seven measurements taken on Well TT-26 from January to September 1985 indicates that the concentrations at this well varied from 3.8 to 1,580 micrograms per liter (see Table 2-8). The model predictions for the same time frame range from 732 to 804 micrograms per liter."

Did I read that correctly?

A. Yes.

Q. "The difference indicates that the real system is highly transient and that the model did not account for temporal and

spatial averaging effects."

Did I read that correctly?

A. Yes.

Q. Now that you've seen the full paragraph, are you willing to offer an opinion about the validity of the last sentence?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I'm not sure what they mean by "temporal and spatial averaging effects." The fact that the simulated concentrations differ from the observed concentrations which vary quite significantly is a phenomenon that we've discussed at length in our -- both our post-audit report and our rebuttal document.

There's a -- there are very good reasons why one wouldn't expect an exact match between the simulated and observed values and why there would be much greater variance in the observed values versus the simulated values.

Q. BY MR. ANTONUCCI: Okay. We'll get into all of those reasons a little bit later. I'd like to continue reading. This is the second-to-last bullet point on Page 49 of Exhibit 12.

It says "Reporting absolute predicted concentrations of PCE and its biodegradation byproducts in finished water delivered by the Tarawa Terrace water-supply system with a precision of up to five significant figures without any error bounds (for example, Jang and Aral [2008] report concentrations of PCE at 102.10 micrograms per liter, TCE at 4.33 micrograms per liter, DCE at 13.75 micrograms per liter, and vinyl chloride at 7.50 micrograms per liter) provides an unwarranted sense of certainty. Such reporting can contribute to misconceptions by the public and the epidemiology-research community such that water-modeling efforts can produce a specific value for contaminant concentration. Posting such precise point estimates for PCE, TCE, DCE, and vinyl chloride concentrations on public web pages (www.atsdr.cdc.gov/sites/

lejeune) and encouraging former Camp Lejeune marines and their families to find the estimated exposure concentrations of these contaminants leads to a misleading perception that reactive transport models can make accurate predictions."

Dr. Jones, is it your opinion that providing numbers such as the ones mentioned in this paragraph without error bars can provide an unwarranted sense of certainty?

MS. BAUGHMAN: Object to the form. Outside the scope.

THE WITNESS: I think that depends on the context.

Q. BY MR. ANTONUCCI: Okay. The last bullet point on this page, that's Page 49 of Exhibit 12, says "In the absence of data, historical reconstruction efforts that use groundwater models can only provide a general conceptual framework for what happened at the site and why. At best, such models may be used only to estimate a range of possible concentrations. Without historical geochemical data, the uncertainty

associated with many of the input parameters (such as the biodegradation parameters) could be very high. In addition, current understanding of subsurface reactive transport processes is inadequate, so" reactive -- excuse me -- "so transport models cannot be expected to provide definitive concentration estimates especially for biodegradation by products."

Did I read that correctly?

A. Yes.

Q. Okay. That's a true statement, isn't it, Dr. Jones?

MS. BAUGHMAN: Object to the form. That's about five statements, it's not one.

THE WITNESS: Yeah, well, I think this, as is the case with some of the reviews, may tend to overestimate, overstate the absence of data. I think they did have quite a bit of data to use to build the flow and transport model. Certainly enough to make it a reasonable and valuable model.

And I think they did a reasonable job of simulating or estimating the uncertainty in the model through their Monte Carlo analysis and presenting that to the public in their reports.

Q. BY MR. ANTONUCCI: Do you agree that in the absence of data, historical reconstruction efforts that use groundwater models can only provide a general conceptual framework for what happened at the site and why?

MS. BAUGHMAN: Object to the form.

THE WITNESS: No, I don't agree with that.

Q. BY MR. ANTONUCCI: Why not?

A. I think it -- it's -- I -- where's the part you read again?

Q. That's the first sentence of the last bullet point on --

A. Okay.

Q. -- Page 49 of Exhibit 12.

A. I think they can go beyond providing a general conceptual framework, as

was done in the case here.

I think what they did with the historical reconstruction is a perfectly valid application of groundwater and contaminant transport model.

Q. What's your understanding of what the NRC is?

MS. BAUGHMAN: Object to the form.

THE WITNESS: National Research Council. It's a -- it's part of the National Academy of Sciences.

Q. BY MR. ANTONUCCI: Is the NRC a well respected institution?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Generally it -- they -- they use experts in their work.

Q. BY MR. ANTONUCCI: Are you aware that Dr. Clement served as a reviewer for this report?

A. Yes.

Q. Earlier you mentioned you're familiar with a critique of ATSDR's water

modeling efforts from -- by Dr. Clement; is that right?

A. That's correct.

Q. Do you have any opinions on that article?

A. I do.

Q. Okay. What are they?

A. Well, as I mentioned, Professor Clement is a good friend of mine and he has a habit of writing thought -- thought-provoking issue papers. And he has a number of these over the years that are meant to push buttons and stimulate conversations.

He typically asks me to review his draft manuscripts of his issue papers and we have a lot of fun discussing the issues, and he enjoys getting reactions and getting people to talk about things.

I did not review this particular article when he published it, nor have we had extensive conversations about it, but it certainly follows the pattern. And if you read his response to Morris' response, in the opening paragraphs he does indicate that one of his objectives was to stimulate

conversation with that.

That being said, when I read the paper, it seemed that a lot of his critiques were -- were directed at the TechFlow -- use of the TechFlowMP model in the modeling study. And in fact he -- I recall he suggested that a better approach would be to stick perhaps with MODFLOW and MT3DMS, which is what we've done in this study and what I think the -- you know, certainly what's documented in Chapters C and F.

And I also think he made some fundamental logical errors in his critique of the -- of the modeling effort.

For example, he stated that with a hindcasting model, the farther you go back in time, the greater the uncertainty. And I -- I do not agree with that, because probably the most certain state of this model is 1953 when it started. That's a point in time when you have a definitive representation of what the model should look like.

So they -- they had

concentration data at the water treatment plant in the -- in the mid '80s. They had concentrations at the wells. And so you could argue that there's -- there's less uncertain -- there's data at that point.

So you're going to from a state -- a known state to another known state. And so there's uncertainty along that path, but you're simulating between two relatively precise states.

Another issue I had with the model with his analysis is he pointed to the -- the uncertainty band of the simulated concentrations at well -- at the Tarawa Terrace water treatment plant, and he looked at the -- the narrow band of uncertainty in the early years of the results as we were discussing a little bit earlier in this deposition.

And he said this is wrong because it implies that -- that there's no -- there's very little uncertainty at that point in time, which is wrong. And I believe Spiliotopoulos made the same critique about the narrow band there.

And as I explained earlier, there's a very important reason why the band is narrow. The -- the -- that plot shows the concentrations at the water treatment plant, which is derived from concentrations at supply wells that are a significant distance away from the source.

So no matter what -- no matter what perturbations or variation you had in the model in those early stages, you would get very small concentrations downgradient during the first few years.

So it has -- has nothing to do with falsely representing the uncertainty. That -- the fact that that band is narrow is a natural mathematical byproduct of the -- of the geometry and the -- and the physics at the site.

Q. Okay. Do you have any other fundamental logical errors that you'd like to point out?

A. No.

Q. All right. When was the last time you reviewed the Clement article?

A. I -- a couple of weeks ago,

maybe.

Q. And you said that you haven't discussed it with Dr. Clement; is that right?

A. That's correct.

Q. Why not?

A. I figured it would be best as I'm serving as an expert on this case and knowing his past involvement to -- to not have that conversation. Save it for a later time.

Q. You don't think he'd want to engage with you in a controversial discussion?

A. Oh, I'm sure he would. But I don't want that to -- my personal relationship with him to impact my -- my -- my work and my conclusions on this.

Q. You mentioned that many of Dr. Clement's critiques were directed at the use of TechFlowMP; is that correct?

A. In my reading of the article, that's the -- that's the sense I got. For example, he -- one of his critiques was we shouldn't use cutting-edge research -- we should be careful or reluctant to use

cutting-edge research models developed in academic institutions that haven't been thoroughly vetted. That certainly would not apply to -- to MODFLOW and MT3D.

Q. Understood.

But is it -- is it your opinion that TechFlowMP has not been thoroughly vetted?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I don't -- I don't -- I don't think it's been vetted to the same degree as MODFLOW or MT3D. That doesn't mean it's not a -- a -- an accurate and valuable model.

Q. BY MR. ANTONUCCI: Do you have any opinion on the accuracy and validity of results generated using TechFlowMP?

A. No.

Q. You have no opinion either way?

A. I haven't studied the TechFlowMP results. We focused mainly on the MODFLOW and MT3DS -- MS as -- within the context of the work were asked to do. Was

not asked to evaluate TechFlowMP or study it.

Q. Okay. It's my understanding that TechFlowMP was generated at the Georgia Institute of Technology by Dr. Aral?

A. That's correct.

Q. Okay. And that was done for the purpose of the Camp Lejeune study; right?

MS. BAUGHMAN: Object to the form. Foundation.

THE WITNESS: I'm not sure what it was -- if that's why it was developed or not. I'm just not -- I'm not aware.

Q. BY MR. ANTONUCCI: Okay. How many other groundwater modeling projects have you evaluated that use TechFlowMP?

A. I don't recall seeing any other.

Q. This is the only one you've evaluated that's used TechFlowMP?

A. That's correct.

Q. Okay. How about published studies, things you've reviewed in the literature. Have you seen TechFlowMP used anywhere else?

A. Not that I recall.
Q. Okay. All right. I would like to discuss hindcasting.
When I say the word "hindcasting," what does that mean to you?
A. Using a model to look back in time and characterize what happened in the past in an aquifer.
Q. Okay. ATSDR's groundwater flow and transport models are hindcasting models; right?
A. That's what they were primarily developed for, yes, to do a historical reconstruction is another term for hindcasting.
Q. So the -- would you consider those terms, "historical reconstruction" and "hindcasting" to be synonyms?
A. Yeah.
Q. Have you ever constructed a historical reconstruction or hindcasting model?
A. Yes.
Q. Okay. I think we discussed a few of those at the beginning of the

deposition; is that right?

A. Correct.

Q. Are there any others that we didn't already mention?

A. Yeah. One in particular, you may or may not be familiar with the -- with the Woburn case near Boston, Massachusetts.

Early in my career I became interested in that case after reading the book A Civil Action and learning about the -- at that site they had PCE contamination in the groundwater, which then traveled to some municipal supply wells resulting in a cluster of childhood leukemia and other things, I believe, in the -- in the Woburn neighborhood.

And I became very interested in the case and I read up on it and I contacted a lot of -- I knew some of the experts who had been involved in the study, such as George Pinder, and I contacted a number of the people who were involved and asked if they had any data they could share with me.

And so I collected a wide variety of data on the site, which I then put

into a website, Woburn hydrogeologic data, or something I think I called it.

And then as I was teaching a graduate course on contaminant -- on groundwater modeling, I ended up developing a series of exercises where each time I teach the class, we study the case and I have the students build groundwater models, and then take opposing sides in the case and critique each other's models and -- and estimate the -- whether or not the contaminant would have reached the wells within a certain time frame and answer questions like that.

I was able to travel to a symposium at Harvard Law School on the case and interact with a lot of the people involved with it, and over the years a number of other university courses have adapted this same set of exercises and materials and content that I developed for this particular model.

MR. ANTONUCCI: I'm showing you what I will have marked for identification as Exhibit 19.

THE REPORTER: 19?

MR. ANTONUCCI: Excuse me, 13.
Thank you.
(Exhibit 13 was marked for identification.)
Q. BY MR. ANTONUCCI: Dr. Jones, do you recognize this?
A. Yes, I do.
Q. How do you recognize this?
A. This is a part of the Woburn case study that I just described to you. This is one of the pieces of information that I provide to my students.
Q. Is this a page from the CE 547 website?
A. Yes, it is.
Q. Did you -- did you create this web page?
A. Yes, I did.
Q. Okay. And have you visited it in the past?
A. Yes.
Q. Okay. Have you read the contents of this web page before?
A. Yeah, I wrote this web page.
Q. Okay. And do you currently remember the contents of this web page?

A. Yes.

Q. Okay. I'd like for you to look at the italicized text in the center which starts with the word "First"?

A. Yes.

Q. This says "First: Had the plaintiffs established by a preponderance of the evidence that any of the following chemicals - TCE, perc, and 1,2 transdichloroethylene - were disposed on the Beatrice land after August 27, 1968 (in the case of W.R. Grace, after October 1, 1964, and the date Well G had opened), and had these chemicals substantially contributed to the contamination of the wells before May 22, 1979?"

Did I read that correctly?

A. Yes.

Q. That appears to be from the jury instructions from Judge Skinner; is that right?

A. Yes. And I took this from the book A Civil Action published in 1995 by Harr.

Q. Okay. So the question posed to

the groundwater modeling experts at Woburn was whether or not contaminants could have reached the pumping wells through the groundwater flow within a certain time frame; is that right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Can you state that again.

Q. BY MR. ANTONUCCI: The question posed to the groundwater modeling experts at Woburn was whether or not contaminants could have reached the pumping wells through groundwater flow in a certain time frame; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Yeah, I think that's accurate.

Q. BY MR. ANTONUCCI: Okay. Were the groundwater modelers at Woburn asked to determine the concentrations of contaminants in the wells at different points in time for determining an individual's potential exposure to contaminants?

MS. BAUGHMAN: Objection.
Form. Foundation.
THE WITNESS: I don't recall.
Q. BY MR. ANTONUCCI: You don't know if the groundwater modelers generated a list of contaminant exposure doses?
A. As part of this initial case, I -- I'm not sure.
Q. Okay.
A. I know that this -- after this -- this civil action was concluded, there was an extensive study by the -- by the USGS, there was a model built. It also became a Superfund site and, you know, there were a lot of different kinds of analyses that were performed.
I also became friends with a professor at Ohio State University who studied this extensively and did a number of simulations, including calculating the concentrations at the wells and then putting those concentrations into a water distribution model to simulate the resulting -- the concentrations of water delivered to different neighborhoods in

Woburn, and then he compared that to incidents of leukemia in the children in those neighborhoods who were in -- in utero when they -- their mothers drank the water, and found a really strong correlation. And that study was then published in Nature, the journal Nature and got a lot of recognition.

So my point is there -- there are a lot of different modeling efforts and analyses associated with this case. It's been very highly studied.

Q. Okay. Specifically for the question you ask your students --

A. Yes.

Q. -- the project you ask them to recreate --

A. Yes.

Q. -- are they determining specific concentrations of contaminants at wells?

A. No. I have them focus purely on travel time and whether or not the contaminants -- it's more likely than not that the contaminants would have reached Wells G and H within the time frame

associated with this case.

Part of my objective is to -- is to frame a -- you know, the case study around an amount of work that could reasonably be done in the course of a university semester.

Q. Sure. The other studies you were discussing, the I think USGS and others --

A. Yeah.

Q. -- those use a EPA net water distribution system modeling software to estimate the movement of contaminants through the water distribution system; right?

A. I don't know about the USGS. I know the study that was done at Ohio State University did that.

Q. Okay. The -- the USGS study -- or what's -- how would you describe your level of familiarity with that study?

A. I know that they -- they built a groundwater model. I have copies of the model. I've looked at the model and the outputs. I looked at the boundary conditions they found, the -- the conceptual model they

used and -- and that -- the manner in which they built that model informed the guidelines that I give my students to -- to recreate the model each semester I -- I teach it. We use the same basic conceptual model and boundary conditions used by the USGS. And I believe we may calibrate to the same data that they had.

Q. The USGS study did not determine specific concentrations of contaminants individuals in Woburn were exposed to; right?

A. I'm not sure. I don't recall.

Q. The USGS study bifurcated into two parts; right?

A. The USGS? I'm -- not that I'm aware of.

Q. The USGS study first looked at whether contaminants could have possibly reached the wells, then whether contamination from the wells would have reached certain neighbors in different proportions.

Does that sound like your understanding of the USGS study?

MS. BAUGHMAN: Object to form

and foundation.

THE WITNESS: I think you may be conflating some different things here. But the -- the description in this Exhibit 13 was based on the evidence presented at the original trial, and in that case there were modeling -- a modeling expert for the plaintiffs, another modeling expert to defense. They had different models and argued for the merits of each, and that's the -- that was bifurcated as described in this -- in this issue.

Now, the -- the other study I was talking about at Ohio State, that was purely, to my knowledge, an academic study. He had a PhD student that worked on that, and like me, he became interested in the case and did that more extensive analysis.

You know, one of the questions in this case -- this was the late '80s, early '90s at a time when our understanding of chlorinated solvents and their impact on health and how

they migrate and degrade in an aquifer was not as well understood as it is now, and so there -- that was one of the -- that was one of the issues in the case.

And -- and so, again, one of the questions was does -- do these contaminants cause the illnesses that were reported in Woburn.

And so one of the objectives of the Ohio State study was he was able to take the -- recreate through the model simulation the concentrations that were reaching the supply wells, and then the next question is once they're in the supply wells, where did they go, right?

Because -- and so the EPA net model -- I believe he used EPA net -- it was a water distribution model similar to EPA net, then simulated where -- which specific neighbors and houses that would go to. And then they did statistical analysis of the correlation between that water

delivery and the incidents of childhood leukemia and found a very strong statistical correlation.

Q. Understood.

You mentioned that your students use the same calibration data that was available to USGS; is that right?

A. That's -- I believe so. I collected my calibration -- I was also in contact with some of the original experts who were involved in the litigation, and so I -- whether my calibration data came from the USGS model or theirs, I'm not positive.

Q. Okay. Regardless of where it came from --

A. Yeah.

Q. -- can you describe that data to me?

A. Yeah. It -- it is measured water levels at a number of observation wells in the Woburn area, and also there's a -- there's a river or a stream that flows through the -- the valley and the -- there were some measure -- and I believe this one was USGS data -- measured the change in flow

across that -- between a gauge at the top of where the model is and a gauge at the bottom to determine how much water in this case was gained. There's water flowing from the aquifer to the river, and the magnitude of that was measured.

So the students calibrate the MODFLOW model to the water levels at the observation wells and to the stream discharges. The discharges to the streams -- stream.

Q. Can you use the discharges to the stream to determine the recharge rate of the aquifer?

A. Yes, it's actually really helpful because based on the -- the closed nature of the -- of the site, there's only one source of water to the aquifer, and that's through recharge.

And then the water leaves the aquifer by being pumped out through the wells that are active at the specific point in time, and also through discharge to the stream.

So, in fact, I instruct my

students you can actually back calculate the recharge in a spreadsheet using a simple water balance method using that data.

Q. What time frame did the water level data cover that you just discussed?

A. I don't recall. I would have to go back and look and see. But we build a steady-state model. We don't build a -- actually, I take that back. I have them build both a steady-state model and then they have the option to make a transient model, but the calibration is the steady-state conditions.

Q. Is that because you don't have well pumping data?

A. No -- well, it's partly because it's -- I don't believe we had water-level data over a long period of time. And, again, I have to construct the case study, it's something that a set of students who are brand new to groundwater modeling can do over the course of a semester, so it's -- it's -- it's a small aquifer. It's a contained system.

Q. Sure. Do you -- do you know if

that data is available, the well pumping data?

A. Oh, so we have -- we use some pumping data in -- in the case, yeah. There are four wells; there are two industrial wells and then Wells G and H and the pumping data's described somewhere in my website.

Q. Do your students calibrate the model to any contamination concentrations?

A. No.

Q. Were contaminant concentrations available to the water modelers in the lawsuit?

A. Yes, I believe so.

Q. Do you know roughly what time period that data spanned?

A. I don't recall. I know once they -- similar to the Camp Lejeune case, once the chlorinated solvents were discovered in the municipal wells, they -- they shut down the wells and stopped pumping.

Q. Okay. So there wouldn't be -- strike that.

I'm sorry, were you going to continue?

A. Well, that -- there are two types of concentrations data. There's the concentration of the water coming out of the well, which I know they measured that. But then I think at a later point in time they went in and started sampling water at monitoring wells throughout the Aberjona aquifer and collected a set of concentration data from that, which was then used to build the models that were used in the court case.

Q. Okay. Maybe zooming out from Woburn --

A. Sure.

Q. -- talking about groundwater modeling in general.

A. Sure.

Q. What are the types of data that are required to create a historical reconstruction groundwater model?

A. That depends on the context.

Q. Sure. Would you ideally have precipitation data for use in creating a hindcasting model?

A. Ideally, yes.

Q. Okay. And that would help you

determine the recharge rate; is that correct?
A. That does inform the recharge rate, typically, yes.
Q. To calibrate the groundwater flow model, would you say that you need water level data?
A. Yes.
Q. And for the flow and transport model, would you say that pumping schedules and pumping rates are helpful in creating a hindcasting model?
MS. BAUGHMAN: Object to the form.
THE WITNESS: I would say, yeah, any of the major, significant what we call stresses, sources and sinks of water you'd want to characterize as best you can based on the data that are available to you.
Q. BY MR. ANTONUCCI: How about the properties of the aquifer, like porosity or other parameters similar to that, would that be helpful in generating a groundwater model?
A. Yes.

MS. BAUGHMAN: Object to the form.

Q. BY MR. ANTONUCCI: Ideally, where do you get information about the aquifer properties from?

MS. BAUGHMAN: Object to the form.

THE WITNESS: It depends on the aquifer properties that you're talking about. One of the ways in which we get hydraulic conductively, for example, is you can go to the site and perform pump tests where you either inject water or pump water out of the aquifer and watch the -- the response of the aquifer, and from that you can back calculate or infer the hydraulic conductivity in the region surrounding the well.

And -- but in some cases we start with our -- our best estimate using scientific and engineering judgment and experience on the parameters, and then use the feedback from the calibration data to help

inform those results.

For example, recharge is hard to quantify, but once you start running the model, if your recharge rate is too high, the whole aquifer floods and you know that's not realistic; where if your recharge rate is too low, your aquifer gets dewatered.

So there are things that you can do as part of the modeling exercise to help narrow down a reasonable range of parameters in your model.

Q. BY MR. ANTONUCCI: Okay. I would appreciate if you could please turn to Exhibit 9, Page A27.

A. Okay.

Q. All right. Page A27 of Exhibit 9, the title of the table is "Summary of model-derived values and observed data of tetrachloroethylene at water-supply wells, Tarawa Terrace U.S. Marine Corps Base Camp Lejeune, North Carolina; is that right?

A. That's correct.

Q. And it looks like this graph shows the model-derived values versus the observed data at Tarawa Terrace; is that correct?
A. Correct.
Q. Is it your understanding that this is all of the water supply well data that ATSDR had available?
A. I would assume so.
Q. Okay. And this is 36 data points; right?
A. Yes.
Q. Okay. And it looks like they were taken in 1985 and 1991; correct?
A. Correct.
Q. Okay. Now I'd appreciate if you could turn to Exhibit 6, that's your initial report.
A. Okay.
Q. And if you could please look at Page 7 in Roman Numerals vii, it's the Executive Summary.
A. This is Exhibit 6?
Q. Yes.
A. Oh, sorry, I thought you said

7-I. Okay. Got it.

Q. Okay. I'm reading from the top of Page 7, the sentence starting with the word "Despite."

A. Yes.

Q. It says "Despite the inherent challenges in simulating complex subsurface conditions and dealing with incomplete data, the model effectively simulates long-term trends in contaminant migration."

Did I read that correctly?

A. Yes.

Q. What did you mean by "the inherent challenges in simulating complex subsurface conditions"?

A. I think I would probably use this sentence to describe just about any groundwater modeling project that I've been familiar with over the course of my career.

When we're looking at groundwater models, we always have -- we're dealing with something that's underground, that you can't directly touch and measure, and so the whole process is based on building the model as best you can from the available

data that you have and overcoming, in a reasonable fashion, the -- the lack of more continuous data.

Q. Okay. And what did you mean by "dealing with incomplete data"?

A. What I just described. I -- there -- I've never in my 34 years in this -- in this profession and my career encountered a case where someone built a model and said, By golly, we had all the data we needed for this project, right?

You're always dealing with incomplete data. But there are standard, established procedures on how to do that and how to assess uncertainty in those cases and how to -- again, I -- I previously -- I mentioned that recharge, which is very hard to measure directly.

And so we use indirect methods to -- to pin down the -- the level of recharge. That process is used in multiple ways in building models.

MR. ANTONUCCI: Is this Exhibit 14?

THE REPORTER: Yes.

MR. ANTONUCCI: Okay. I'm handing you Exhibit 14.

(Exhibit 14 was marked for identification.)

Q. BY MR. ANTONUCCI: Dr. Jones, have you seen this before?

A. It certainly looks familiar, yes.

Q. Where have you seen this before?

A. That would appear to be a poster. I believe I presented this at the American Geophysical Union meeting, annual meeting.

Q. Could you please turn to the --

THE VIDEOGRAPHER: Sorry, can you...

Q. BY MR. ANTONUCCI: Could you please turn to the page with the title "Augmenting Sparse Groundwater Level Data With Earth Observations via Machine Learning" with the multiple text box -- text boxes on it.

A. Sure.

Q. I believe that's the second page.

A. Oh, okay, yeah.

Q. If you could look at the box entitled "Data Gaps"?

A. Yes.

Q. Here this says "Monitoring wells are often samples at irregular or sporadic intervals. It is not uncommon for monitoring wells to be abandoned, or to have quite brief periods of record. We may have only one or two years of information from the well. How can we use machine learning to best make use of what little data we have?"

Did I read that correctly?

A. Yes.

Q. So according to this poster, one or two years of information from a well is a brief period of record; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Depending on the context.

Q. BY MR. ANTONUCCI: Okay. Are you currently researching ways to address the issue of sparse groundwater level data and groundwater modeling by using machine

learning?

A. Yes, although I would characterize it as the -- the primary objective of the research we're doing here with this algorithm is to help scientists and water managers accurately determine how their groundwater storage is changing over time so that they can determine if their groundwater resources are being used sustainably.

And one of the challenges in -- in generating a time history of aquifer storage change is we have to work with water levels measured at wells, and some wells have a -- a -- a relatively complete record over a long period of time.

Other wells have -- may go years between measurements or have measurements that only cover a short time span. And we're exploring machine learning algorithms that combine the data you do have with satellite data, earth observations to -- to intelligently infer the missing data so that you can more accurately build an aquifer storage versus time curve that can be used by water managers to address aquifer

sustainability.

Q. Okay. And to be totally clear, machine learning is not something that was applied to ATSDR's Tarawa Terrace groundwater flow or transport model; right?

A. Not to my knowledge.

Q. You can put that exhibit aside. Thanks, Dr. Jones.

A. Sure.

Q. Is it fair to say that a modeler's goal might be to keep a model simple enough to be manageable yet complex enough to be useful?

A. That's a -- that's a common expression we use, yes.

Q. Okay. And would you agree with the phrase that one should start simple and build in complexity only as needed?

A. Yes, in general.

Q. Okay. That's sort of the theory underpinning model parsimony; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Yeah, that's -- that -- model parsimony is having the

right level of -- the level of complexity in your model warranted by the purpose of the model and what it's going to be used for and the -- the nature of the site that you're modeling.

Q. BY MR. ANTONUCCI: Theoretically, it's true to say that there are an infinite number of combinations of model parameters that will calibrate the same model; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: It depends on the context. Not in -- there are certain circumstances where that could apply, but it's not true as a general statement.

Q. BY MR. ANTONUCCI: Okay. What is the problem of nonuniqueness in the context of groundwater modeling?

A. Depending on how a model is built, if -- if you have -- for example, let me refer back to the -- earlier I mentioned that we can use stream flow data to pin down

our recharge value.

Suppose you have an aquifer where all you have are water level measurements and no -- no -- no estimates on discharge, and that -- that could become a little more problematic in pinning down your recharge value.

And so there are certain conditions where if a -- if the conceptual model is overly simplistic or your boundary conditions are not well posed, you can achieve a mathematical situation where, for example, you could plug in any value of hydraulic conductivity and get the same heads out of it.

So it's something that modelers need to be aware of. It's something that I teach in my groundwater modeling class. But it -- it's -- I certainly would never say that for any given model there are an infinite number of parameters that would reasonably calibrate it.

Q. It is fair to say, though, that multiple sets of model input parameters could calibrate to a single set of observed data;

right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I -- again, it depends on the context. I wouldn't say that as a general statement.

MR. ANTONUCCI: I'm going to introduce Exhibit 15.

(Exhibit 15 was marked for identification.)

Q. BY MR. ANTONUCCI: Dr. Jones, you've seen this before, haven't you?

A. It looks like one of my exams, yes.

Q. Okay. I'll represent to you that I pulled this off the website for your groundwater modeling class.

Are you familiar with the content of this exam?

A. Yes, I am.

Q. Okay. You've seen it before?

A. Yes.

Q. And you currently know what the information on this exam is; right?

A. Yes.

Q. Okay. I'd like you to look at

Question 4, please.

A. Yes.

Q. It reads "(calibration) Model non-uniqueness occurs when:" Answer: "b. Multiple sets of model input parameters will calibrate to a single set of observed data."

Did I read that correctly?

A. That's correct.

Q. Okay. That means there could be more than one calibrated model that fits a given data set; right?

A. You notice the way that's phrased, "model uniqueness occurs when." That -- basically there are certain conditions, depending on how the model was built, where the model can end up being nonunique. That doesn't mean that all models are nonunique.

Q. So with regard to the ATSDR model, theoretically a model that sits outside the uncertainty range of their model could still be a good fit to the post-audit data; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Say that again.

Q. BY MR. ANTONUCCI: Theoretically, there could be a model that sits outside the uncertainty range of the ATSDR model that is still a good fit to the post-audit data set; right?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I'm sorry, one more time. I got to make sure I get the correct answer here.

Q. BY MR. ANTONUCCI: Theoretically, there could be a model that sits outside the uncertainty range of the ATSDR model that is still a good fit to the post-audit data set; right?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Not necessarily.

Q. BY MR. ANTONUCCI: Dr. Jones, is a non- --

MS. BAUGHMAN: Wait. Were you finished answering?

THE WITNESS: Well -- no. So from my understanding of what they did

is they calibrated the model and got a set of parameters which best fit the -- the observed heads and concentrations, and then in the uncertainty analysis, they perturbed those over a wide range of values and looked at the effect on the -- on the outcome, the concentrations. That means they explored a broad range of models.

Now, whether outside of that range there could be models that -- that would adequately calibrate, I can't say.

Q. BY MR. ANTONUCCI: Okay. Is it your opinion that the post-audit calibrated model is the only model that could fit the data ATSDR had?

A. Well, the -- the post-audit was not a calibration exercise.

Q. Excuse me. I'll re-ask my question.

Is it your opinion that ATSDR's calibrated model is the only model that could fit the data ATSDR had?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I think it's a model that reasonably and accurately fits the data that they had.

Q. BY MR. ANTONUCCI: Is it the only one that reasonably and accurately fits the data they had?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I can't say.

Q. BY MR. ANTONUCCI: Why not?

A. I think it's an overly restrictive question.

Q. Can you explain what would need to change for you to be able to answer your question?

MS. BAUGHMAN: Object to the form.

THE WITNESS: Well, I would need you to explain more what you mean. What are the circumstances that you're talking about? If you could -- it's a general statement. That's why I'm nervous about giving a definitive

answer.

Q. BY MR. ANTONUCCI: Dr. Jones, is a nonunique model a useful predictive tool?

MS. BAUGHMAN: Object to the form.

THE WITNESS: A model that is -- it depends on the level of nonuniqueness. I would say with every model there's -- there's some variability in the calibration, right?

It's not a yes-or-no question whether or not a model is unique. There are levels of uniqueness. In fact, there are actual numerical analyses that you can do to analyze uniqueness.

When I teach the calibration section of my groundwater class, we use the PEST model. And one of the outputs from the PEST model is a number, it's a set of eigenvalues and you can look at that number and determine its -- it's a measure of the level of uniqueness.

So if that number is within a certain range, you say there's good evidence that the model is relatively unique. If it's beyond a certain range, then it's evidence that there's nonuniqueness at play.

But it's not -- that's why I'm not comfortable with your question, is it's not a -- it's not a black and white boundary between unique and nonunique models. It's a spectrum.

Q. BY MR. ANTONUCCI: Sure. Did you evaluate the ratio of eigenvalues that the calibrated model ATSDR made?

A. No, I did not.

Q. Why not?

A. That would have required running a PEST simulation. It was -- it was not within the scope of work that we were asked to do.

Q. Okay. How can a modeler make a model more unique?

A. More data. And it's not just the amount of data, it's the types of data that you have. For example, with the ATSDR

model, the -- they had -- from what I, in my judgment, was a pretty rich data set to -- to calibrate the flow model.

Then for the transport model, you know, the initial condition was zero contaminants represents, you know, one bound. And on the other end they had a combination of -- of water levels -- or excuse me -- concentrations at the wells plus the water treatment data.

The combination of the concentrations at the water treatment plant plus the concentrations simulated at the observation wells, in my opinion, makes the model more unique.

Now, I would also argue that at this point in time we have another 318 point observations at monitoring wells at a later date, which I believe the model does a -- does a good job of simulating; therefore, providing additional evidence for the -- for the accuracy and uniqueness of the model.

Q. Dr. Jones, you agree that it's impossible to fully characterize and incorporate all parameters and complexities

of a real aquifer system into a discretized computer model; right?

A. Correct.

Q. Okay. ATSDR had no site-specific data for estimating the distribution coefficient; right?

MS. BAUGHMAN: Object to the form and foundation.

THE WITNESS: I'm not -- I don't know. Not that I'm aware of.

Q. BY MR. ANTONUCCI: Would reviewing Chapter F help you remember?

A. It could.

Q. Okay. I'd like you to turn to Page F27.

A. Let's see, exhibit -- I'm getting a stack here.

Q. Chapter F is Exhibit 11.

A. Okay. Okay.

Q. Okay. I am looking at the last full paragraph on Page F27, starting with the word "Estimates."

A. Yes.

Q. This says "Estimates of retardation factors and distribution

coefficients for PCE migration within the Tarawa Terrace aquifer or Castle Hayne aquifer are unknown, and initial estimates applied to the MT3DMS model were based on literature sources."

Did I read that correctly?

A. Yep.

Q. That help you remember whether they had data for the distribution coefficient?

A. Yes.

MS. BAUGHMAN: Object.

Q. BY MR. ANTONUCCI: Okay. Did they have site-specific data to estimate the distribution coefficient for the ATSDR TT model?

A. No.

Q. Okay. Instead, ATSDR reviewed literature sources; right?

A. Correct.

MR. ANTONUCCI: All right. I'd like to take a break now.

THE VIDEOGRAPHER: We're off the record. The time is 2:42.

(There was a break taken.)

THE VIDEOGRAPHER: We're back on the record. The time is 2:56. This is Media Number 4.

Counsel may proceed.

Q. BY MR. ANTONUCCI: Dr. Jones, what is your understanding of how the data from ATSDR's Tarawa Terrace model was to be used?

MS. BAUGHMAN: Objection. Form. Foundation.

THE WITNESS: So are we through with this discussion on the --

MR. ANTONUCCI: Yep, you can put that to the side.

THE WITNESS: Okay. All right.

MR. ANTONUCCI: I'll ask again.

Q. What is your understanding of how the data from ATSDR's Tarawa Terrace model was to be used?

MS. BAUGHMAN: Objection. Form and foundation.

THE WITNESS: From my understanding, the primary objective was to do a historical reconstruction of the PCE concentrations at the

Tarawa Terrace water treatment plant between 1953 and when the plant was shut down.

Q. BY MR. ANTONUCCI: Okay. I'd ask that you turn to Exhibit 9. That's TT Chapter A Page A1.

A. Exhibit 2?

Q. Exhibit 9.

A. Did you say Chapter A?

Q. Yes. Exhibit 9 is also a copy of Chapter A.

A. I'm sorry. Let me grab your copy. What page again?

Q. A1. That's the page ending in Bates Number 615652.

A. Okay.

Q. All right. In the column underneath the word "Abstract," I'm reading the third sentence starting with the word "Because."

"Because scientific data related to the harmful effects of VOCs on a child or fetus are limited, the Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of

Health and Human Services, is conducting an epidemiological study to evaluate potential associations between in utero and infant (up to one year of age) exposures to VOCs in contaminated drinking water at Camp Lejeune and specific birth defects and childhood cancers. The study includes births occurring during the period 1968 to 1985 to women who are pregnant while they resided in family housing at Camp Lejeune. Because limited measurements of contaminant and exposure data are available to support the epidemiological study, ATSDR is using modeling techniques to reconstruct historical conditions of groundwater flow, contaminant fate and transport, and the distribution of drinking water contaminated with VOCs delivered to family housing areas."

Did I read that correctly?

A. Yes.

Q. Please turn to Page A98. That page ends in Page Number 615749.

A. Okay.

Q. All right. I am looking at the last paragraph on this page. It looks like

it's a question and answer section. Here the question reads "ATSDR's historical reconstruction analysis documents that Tarawa Terrace drinking water was contaminated with PCE that exceeded the current maximum contaminant level (MCL) of 5 micrograms per liter during 1957 and reached a maximum value of 183 micrograms per liter. What does this mean in terms of my family's health?"

Did I read that correctly?

A. Oh, hang on, I was looking at the wrong paragraph.

MS. BAUGHMAN: Where -- just tell him -- where are you reading from?

THE WITNESS: The blue paragraph on the left. I think you might be on the wrong page. It's A98.

MS. BAUGHMAN: I thought he said 97, okay.

THE WITNESS: Okay, yes, I -- I believe you read that correctly.

Q. BY MR. ANTONUCCI: Okay. Now I'm looking at the paragraph in black text on the right next to what I just read.

Do you see that?

A. Yeah.

Q. It reads "ATSDR's exposure assessment cannot be used to determine whether you, or your family, suffered any health effects as a result of past exposure to PCE-contaminated drinking water at Camp Lejeune."

Did I read that correctly?

A. Yes.

Q. It goes on to say "The study will help determine if there is an association between certain births defects and childhood cancers among children whose mothers used this water during pregnancy."

Did I read that correctly?

A. Yes.

MR. ANTONUCCI: Okay. I am now going to hand you what will be marked for identification as Exhibit 16.

(Exhibit 16 was marked for identification.)

Q. BY MR. ANTONUCCI: Okay. For the record, Exhibit 16 has the Bates range CLJA_WATERMODELING_01-09_0000033263 through 33326.

Dr. Jones, this document has the title "Analyses of Groundwater Flow, Contaminant Fate and Transport, and Distribution of Drinking Water at Tarawa Terrace and Vicinity, U.S. Marine Corps Base Camp Lejeune, North Carolina: Historical Reconstruction and Present-Day Conditions Response to the Department of the Navy's letter on: Assessment of ATSDR Water Modeling for Tarawa Terrace."

Dr. Jones, have you seen this before?

A. Yes, I have.

Q. Okay. I'm going to ask you to turn to the page ending in Bates Number 33272.

A. Okay.

Q. All right. Looking at the last full paragraph on that page, this says "To address the issue of the intended use of the water-modeling results by the current ATSDR epidemiological study" --

A. Excuse me, I think I might be on the wrong page. What -- what was the page number? Is it 33272?

Q. Yes, sir.
A. And which paragraph are you -- oh, the last paragraph. Okay, I gotcha.
Q. So the last paragraph on Page 33272 of Exhibit 16 states "To address the issue of the intended use of water-modeling results by the current ATSDR epidemiological study, the DON should be advised that a successful epidemiological study places little emphasis on the actual (absolute) estimate of concentration and, rather, emphasizes the relative level of exposure. That is, exposed individuals are, in effect, ranked by exposure level and maintain their rank order of exposure level regardless of how far off the estimated concentration is to be 'true' (measured) PCE concentration."
Did I read that correctly?
A. Yes.
Q. Okay. So, Dr. Jones, the paragraph I just read states that a successful epidemiological study places little emphasis on the actual absolute estimates of concentration; right?

A. Yes.
Q. Okay. In your report you opine that the model remains a reliable tool for understanding general trends of contaminant migration in the Tarawa Terrace region, and that you can find no significant evidence that would invalidate the analysis performed by ATSDR with the original model; right?
A. Correct.
Q. However, you're not offering an opinion that the Tarawa Terrace model is a sufficiently reliable model for determining quantitative levels of contaminant exposure for an individual; right?
MS. BAUGHMAN: Object to the form. Foundation. Outside the scope.
THE WITNESS: I am not an expert in epidemiology, so I don't feel qualified to render an opinion on that question.
Q. BY MR. ANTONUCCI: Okay. So you're not offering the opinion that the Tarawa Terrace model can be used to determine quantitative levels of contaminant exposure for individuals?

MS. BAUGHMAN: Object to the form.

THE WITNESS: I don't believe I've -- again, my answer's the same. I'm not an epidemiological expert so I can't comment on that.

Q. BY MR. ANTONUCCI: Can I have a yes or a no?

MS. BAUGHMAN: No -- objection.

You do not have to answer yes or no.

Q. BY MR. ANTONUCCI: Are you offering the opinion or not?

MS. BAUGHMAN: Object to the form. Asked and answered.

THE WITNESS: Could you restate the question.

Q. BY MR. ANTONUCCI: You're not offering the opinion that the Tarawa Terrace model is a sufficiently reliable model for determining quantitative levels of contaminant exposure for an individual; right?

MS. BAUGHMAN: Objection; form.

Objection; Foundation.

THE WITNESS: The -- the opinions we've rendered on the model was that in terms of the -- how the model simulates concentrations at the water treatment plant, it -- it is a reasonably accurate model developed using sound scientific and engineering principles.

How that -- concentrations resulting from that are then incorporated in an epidemiological study is outside my scope of expertise -- expertise.

Q. BY MR. ANTONUCCI: So that is not an opinion you're offering?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: No, that's not an opinion I'm offering.

Q. BY MR. ANTONUCCI: Had you done a post-audit prior to the Tarawa Terrace post-audit?

MS. BAUGHMAN: Objection to form.

THE WITNESS: In the sense of

running a model simulation and comparing its output to field observed values, I have done that countless times.

Q. BY MR. ANTONUCCI: You just described calibration, didn't you?

A. In a -- no. Calibration is when you then take the results of that and go back and change the input parameters.

But I would say what I just described is a subset of what you do for calibration. But simply comparing model outputs to field observed values is -- is a really simple and very common thing that I've done countless times.

Q. Have you ever published a post-audit before?

A. No.

Q. How long did it take you to perform the Tarawa Terrace post-audit?

A. The initial post-audit we started in, I believe, early September and submitted it in late October of 2024.

Q. So roughly a month?

MS. BAUGHMAN: Objection to

form.

THE WITNESS: A little over a month.

Q. BY MR. ANTONUCCI: And you did both a qualitative and quantitative assessment as part of your post-audit; is that right?

A. That's correct.

Q. Are quantitative and qualitative assessments terms of art applied to post-audits?

A. Excuse me? Terms of art?

Q. Are those -- do those terms have any special significance in the modeling community?

A. Yeah, I would say it's a relatively standard practice. For example, one of the most common ways to assess the -- the results of a model calibration is to visually examine a simulated versus observed plot and see how close the points plot to the -- to the -- the line of agreement, which is what I would call a qualitative assessment of the goodness of fit.

Q. Okay. There are also

quantitative assessment of goods of fit; right?

A. Yes.

Q. That would include summary statistics like mean error and mean absolute error; right?

A. And -- yes, and geometric bias is one of those, yes.

Q. Okay. I'd like to discuss those error metrics in more detail, but first you issued two reports in this case; right?

A. Correct.

Q. One was an initial report and the other was a rebuttal; right?

A. Yes.

Q. In your rebuttal report you corrected errors highlighted by Dr. Spiliotopoulos in his expert report; right?

A. Yes.

Q. That included truncation errors, incorrect mass loading end date, and an incorrect pumping rate for well RWC2; right?

A. That's correct.

Q. After Dr. Spiliotopoulos identified errors in your post-audit, did you go back and confirm that the rest of the post-audit had been done correctly?

A. We had -- I'm not aware of any other reason to believe there were errors in the initial post-audit.

Q. After Dr. Spiliotopoulos identified errors, did you go back and check for any others?

A. No.

Q. So you only corrected errors that Dr. Spiliotopoulos pointed out?

A. That's correct.

Q. Are you aware of any other model input errors in your post-audit?

A. No.

Q. Are you now confident that you've found and resolved all model input errors in your post-audit?

A. I believe so.

Q. Could there be more model input errors in your post-audit?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: It's possible.

Q. BY MR. ANTONUCCI: Okay. Please turn to your initial report, that's Exhibit 6. Page 5-1.

A. Okay.

Q. All right. Are you looking at the page that has the heading "Results"?

A. Oh, sorry. 5-1 did you say?

Q. Yes.

A. I have it now.

Q. Okay. I'm looking at the last sentence of the first paragraph. It reads "Before presenting the results, it is helpful to remember that when simulating the migration of a PCE contaminant plume using MODFLOW and MT3DMS, achieving a close match between simulated and observed concentrations can be challenging for several reasons."

Did I read that correctly?

A. That's correct. And what I was talk- -- what we were talking about in this case is looking at individual observed concentrations and expectations regarding how well the model will reproduce those concentrations in the simulation on a

point-by-point basis.

Q. Okay. With all due respect, Dr. Jones, my question was did I read that correctly. I need you to limit your answers to my questions, okay?

A. Sorry. Will do.

Q. Thank you.

You go on to list reasons why it's helpful to remember that achieving a close match between simulated and observed concentrations can be challenging; right?

A. Correct.

Q. Those four reasons include complex subsurface conditions, temporal variability, limitations in model resolution, and measurement variability; right?

A. Correct.

Q. Okay. Under the subheading "Complex Subsurface Conditions," that's Number 1.

A. Yes.

Q. You wrote that "The subsurface environment is inherently complex, with variations in soil heterogeneity, permeability, porosity, and hydraulic

conductivity. These properties vary spatially in ways that are not fully captured in the model, affecting how the contaminant plume moves through the groundwater system."

Did I read that correctly?

A. That's correct.

Q. Next Number 2, "Temporal Variability," you wrote "The concentration of contaminants can change over time due to factors like seasonal variations in groundwater flow, biodegradation, chemical reactions. Simulating these dynamic processes accurately over the entire simulation period is challenging."

Is that correct?

A. Correct.

Q. Okay. Number 3 says "Limitations in Model Resolution: MODFLOW and MT3DMS rely on discretizing the subsurface into numerical grids consisting of cells that represent a subset of the aquifer. The resolution of these grids can limit the model's ability to capture fine-scale variations in plume behavior, particularly in areas with sharp concentration gradients,

small-scale heterogeneities, or preferential pathways."

Did I read that correctly?

A. Yes.

Q. Number 4 says "Measurement Variability: The observed concentrations at observation wells may contain some degree of measurement error or uncertainty. Field data collection is subject to variability, which adds another layer of complexity with trying to match it closely with model outputs. As outlined above in Section 4.2, extreme variations were observed in some of the measured concentrations used in this post-audit."

Did I read that correctly?

A. Yes.

Q. Okay. I'd like for you to turn to your rebuttal report, Page 3-12. That's going to be Exhibit 7.

A. What was the page again?

Q. 3-12.

A. 3-12. Okay.

Q. Okay. Dr. Jones, the second paragraph on this page reads "We have also

generated new versions of each of the tables and figures from our original post-audit" reporting -- "report featuring simulated PCE values, using the updated post-audit simulation results, processed at full precision. These results are presented in Appendix A. The differences in the tables and figures relative to the original report are relatively minor overall. The differences are summarized as follows:"

Did I read that correctly?

A. Yes.

Q. Dr. Jones, this section says that the differences between the corrections you made to your post-audit are relatively minor overall; is that right?

A. That's correct.

Q. Okay. And the table below that paragraph summarizes the list of changes to the tables and figures of your report; is that right?

A. That's correct.

Q. Okay. I'd like you to turn back to your original report, Page vi, six in Roman numerals. Again, your original report

is going to be Exhibit 6.

A. Okay.

Q. Are you looking at the Executive Summary?

A. Yes.

Q. All right. I am looking at the third paragraph from the bottom beginning with the sentence -- the phrase "The extended."

Do you see where I am?

A. Yes.

Q. This reads "The extended MT3DMS model was found to perform well in simulating PCE concentrations at monitoring wells across the study area. The errors are remarkably well balanced, indicating a good overall fit between simulated and observed concentrations."

Did I read that correctly?

A. Yes.

Q. Now, Dr. Jones, for the purposes of evaluating fit between simulated and observed concentrations you provided some summary statistics; is that right?

A. Correct.

Q. Okay. What is residual error?
A. At a particular observation well location it's the difference between the model simulated concentration and the observed concentration.
And the way we calculated it, we took the simulated value minus the observed value.
So if the model overestimates the concentration, it would be a positive residual error; if the model underestimated the concentration, it would represent a negative residual error.
Q. Okay. The mean error is the average of the residual errors; right?
A. That's correct.
Q. And mean absolute error is the average of the absolute value of the residuals?
A. That's correct.
Q. The mean error of the initial post-audit was 21 micrograms per liter; correct?
A. That's correct.
Q. The mean absolute error of your

initial post-audit was 334 micrograms per liter; correct?

A. That's correct.

Q. Dr. Jones, a negative mean error indicates that a model under predicts observed values; correct?

A. That's correct.

Q. A positive mean error indicates that a model over predicts observed values; correct?

A. Correct, on average.

Q. Mean absolute error is also a metric that's used to evaluate overall fit between simulated and observed concentrations; correct?

A. It's -- it's a different statistical measure used to fit -- to analyze the calibration results, yes.

Q. Okay. And the mean absolute error cannot be negative; right?

A. That's correct.

Q. For your updated post-audit, the mean error was 48 micrograms per liter; right?

A. Yes.

Q. That's an increase of 27 micrograms per liter from the original post-audit results?

A. That's correct.

Q. Did you calculate the mean absolute error for the updated post-audit?

A. I don't recall.

Q. Your groundwater modeling software, GMS, provides the summary statistics automatically, doesn't it?

A. Yes. But to calculate these errors, we typically just took the -- the simulated versus observed PCE concentrations as shown, for example, in Table A1 of the rebuttal report and did the error analysis using Excel, Microsoft Excel. It's a very simple equation.

Q. Okay. So you -- you did that very simple equation for the initial report but not the rebuttal report; is that right?

A. Well, I'm sure I have a spreadsheet with that number in it. Whether that number was reported in the rebuttal report, I don't recall.

I would expect that number to

be roughly similar to the -- to the value reported in the initial report, certainly along the same scale, which is relatively large considering a large -- indicating a large variability in the PCE concentrations.

Q. But sitting here today, you do not know the mean absolute error of your updated -- or your rebuttal post-audit?

A. That's correct. I couldn't tell it off the top of my head.

Q. Okay. Earlier you mentioned geometric model bias as another summary statistic that could be used to evaluated fit between simulated and observed concentrations; is that right?

A. That is correct.

Q. When a ratio of simulated PCE concentrations is simulated to observed PCE concentrations is less than one, that indicates under-prediction by the model; correct?

A. That's correct.

Q. And when the ratio of simulated PCE concentration to observed PCE concentrations equals one, that indicates

exact agreement; correct?

A. That's correct.

Q. When the ratio of simulated PCE concentrations to observed PCE concentrations is greater than one, that indicates over-prediction by the model; correct?

A. Correct.

Q. The further the geometric model bias is from a value of one, the worse the agreement between simulated and observed concentrations; correct?

A. That's correct.

Q. Okay. I would like to direct your attention to Exhibit 9, Page A26. And Exhibit 9 is the Tarawa Terrace Chapter A report.

A. Okay. A26, got it.

Q. All right. Do you see Table A8 at the top of the page?

A. Yes.

Q. Okay. In the one, two -- third column from the top, in the -- excuse me -- third row from the top in the Resulting Calibration Statistics column, geometric model bias is indicated as being equal to 5.8

backslash or 3.9.

Do you see that?

A. Yes.

Q. Okay. ATSDR calculated two geometric model biases for the Tarawa Terrace calibrated model; correct?

A. That's correct.

Q. One was the geometric model bias that used data for TT-23; is that right?

A. Yes.

Q. And that was the 5.9 value?

A. 5.8. It says 5.8 in this table.

Q. It does.

If you turn to Page A25. At the top of the right-hand column I'm reading the sentence that says "The inclusive geometric model bias, using data for water-supply Well TT-23, was 5.9."

A. Okay.

Q. See that?

A. Sure.

Q. "The selected geometric model bias, omitting data for supply Well TT-23 was 3.9."

A. Yes.

Q. "Both results, however, indicate over-prediction by the model."

Did I read that correctly?

A. Yes.

Q. Dr. Jones, I would like you to turn to Exhibit 7, that's your rebuttal report, Figure A2.

A. Yes.

Q. Okay. And here we're looking at a graph. On the Y axis we have simulated PCE concentrations in micrograms per liter, the X axis we have observed PCE concentrations in micrograms per liter; right?

A. That's correct.

Q. That dashed line in the middle is where the simulated and observed concentrations are equal; right?

A. That's correct.

Q. Okay. Earlier you indicated that a scatter plot like this one can be used for a qualitative assessment of the goodness of fit of a model; is that right?

A. Yes.

Q. And that's because you can visually examine how far the points are from the one to one line; is that right?
A. Yes, and also the clustering and -- and distribution.
Q. Okay. Please turn to Figure 5 of your rebuttal report. And that's Exhibit 7.
A. Okay.
Q. This figure shows the graph that we were just looking at on the right-hand side of the page; is that right?
A. Yes.
Q. And it shows a similar plot from your initial report on the left-hand side of the page; right?
A. Correct.
Q. In your rebuttal report you state that while the numbers indicate a high degree of variance, they're visually more balanced than the results we originally presented in the post-audit report; right?
A. Correct.
Q. Quantitatively the updated post-audit indicates a small increase in the

bias compared to the initial post-audit; right?

A. Say that again.

MS. BAUGHMAN: Object to the form.

Q. BY MR. ANTONUCCI: The updated post-audit indicates a small increase in the bias compared to the initial post-audit?

A. Based on the mean error, yes.

Q. I'd like you to turn to Page 3-5 of your rebuttal report. I am looking at the one, two -- third paragraph from the top of the page beginning with "In Section 3.1.2."

Do you see where I am?

A. Yes.

Q. All right. About halfway down the paragraph a sentence starts with "For the original post-audit."

Do you see that?

A. Yes.

Q. "For the original post-audit results we calculated a mean error value equal to 21 micrograms per liter, indicating an extremely balanced fit with only a small

high bias. For the updated post-audit results, the mean error equals 48 micrograms per liter, indicating a small increase in the bias, but still relatively well balanced overall."

Is that correct?

A. That's correct. When you -- when you asked that before, I thought maybe you were talking of the post-audit versus the original report, so I apologize for the misunderstanding. Excuse me, versus the original model.

Q. Please turn to Table A2 in your rebuttal report. Again, that's Exhibit 7.

MS. BAUGHMAN: What page did you say?

MR. ANTONUCCI: Table A2.

Q. Are you looking at Table A2, Dr. Jones?

A. Yes.

Q. Okay. So this table shows the monitoring wells, the layer in the model where the well is screened, mean error, mean absolute error, and the mean absolute error category; correct?

A. That's correct.
Q. Okay. Earlier you indicated that the mean absolute error is the absolute value of the mean error; correct?
A. No. It's the -- well, yes, you can calculate it that way, sure.
Q. Okay. I'd like you to take a look at Well C3.
A. Okay.
Q. Here the mean error is indicated as being 98 micrograms per liter and the mean absolute error is indicated as being 124.5 micrograms per liter.
Do you see that?
A. Yes.
Q. Why are those numbers different?
A. That is a great question. I'm not sure.
Q. I'd like you to look at Well C9. Here the mean error is negative 5.9 micrograms per liter, the mean absolute error is 6 micrograms per liter.
A. Yes.
Q. Why are those numbers

different?

A. Because they're displayed using different significant figures.

Q. Okay. I'd like you to look at Well C13.

A. Okay.

Q. Here the mean error is negative 555 micrograms per liter, the mean absolute error is 563.7 micrograms per liter.

A. Yes.

Q. Why are those numbers different?

A. I'm not sure.

Q. Okay. Look at Well C17-D. Here the mean error is negative 0.2, the mean absolute error is 0.4.

Why are those numbers different?

A. I'm not sure.

Q. Okay. If you look at Well RWC-1, the mean error is 251.9, the mean absolute error is 252.6; right?

A. Correct.

Q. Why are those numbers different?

A. I'm not sure.
Q. If you look at Well RWS-3A, the mean error is negative 83.8; correct?
A. Yes.
Q. The mean absolute error is 136.4; right?
A. Correct.
Q. Why are those numbers different?
A. The -- well, you -- when you calculate the mean error, you calculate the average of all of the individual errors. To calculate the mean absolute error, you don't simply take the absolute value of that number.
What you do is you take the absolute value of the individual residuals one by one and then calculate the mean of those values. And I suspect the reason there are some differences here is because of that difference in how they're calculated. It is not simply taking the absolute value of the mean error.
Q. Okay. You did say that earlier, though; right?

A. Excuse me?
Q. You said that the mean absolute error is the absolute value of the mean error?
A. Yes, but on an individual basis. And so I'm -- I -- if -- if I stated that misleadingly, then I'm correcting that now.
Q. Okay. Why don't you take a look at Well S2.
MS. BAUGHMAN: Were you -- were you finished with your answer, Norm?
THE WITNESS: Yeah, I think so.
MS. BAUGHMAN: Okay.
Q. BY MR. ANTONUCCI: All right. Well S2.
A. Uh-huh.
Q. Mean error negative 73.8.
A. Yes.
Q. Mean absolute error 111.6.
A. Right.
Q. Is that a rounding error?
A. No. These -- these are not -- these should not be expected to agree. And let me explain why.

Suppose you had a circumstance where you had a number of positive residual errors and a number of negative residual errors, but somehow they -- they balanced, right?

They -- they -- let's say you had a negative ten, a negative five, and a positive ten and a positive five. If you took the mean of those errors, that would equal zero indicating a perfect balance.

But if you first took the absolute value of those numbers and then took the average of that, you'd be averaging ten, five, ten, and five. And the mean of that would be 7.5.

So, no, the mean absolute error is not simply the absolute value of the mean error.

Q. Okay. When you report the mean absolute error in your -- when you reported that in your initial report, which method of calculating did you use?

A. What I just described. You take the absolute value of the individual residuals, and then calculate the average of

that. There are circumstances under which your mean error will match the mean absolute error.

For example, if all of your errors are negative or if all of your errors are positive, then your mean error and your mean absolute error will match, and that's why it matches in some of these cases but not others.

Q. Okay. Okay. Another point of clarification that I'd appreciate, if you look at Table 1 of your initial report, and that's going to be Exhibit 6.

A. Okay.

Q. This table shows various publicly available rainfall data; is that right?

A. Yes.

Q. Okay. And it shows publicly available rainfall data from 1995 to 2009; right?

A. Correct.

Q. At the Wilmington Airport, Wilmington 7N, and New River MCAF stations; is that right?

A. That's correct.
Q. Okay. Okay, I am going to mark for identification Exhibit 17.
(Exhibit 17 was marked for identification.)
MR. ANTONUCCI: For the record, this is the native spreadsheet version of the document produced with Bates Number CL_PLG --
MS. BAUGHMAN: Sorry, did you give me one? I don't have one.
MR. ANTONUCCI: Dash EXPERT_DAVIS_0000000203.XL -- excuse me -- 203. That's the end of the Bates number.
Q. Dr. Jones, are you familiar with this?
A. It looks familiar.
Q. This is the rainfall data you used to calculate the effective rainfall recharge rate for the post-audit; right?
A. I believe so.
Q. Okay. Can you please look at the year 1999.
A. Uh-huh.
Q. Is there data available there?

A. No.
Q. Okay. Can you look back at Table 1 in your initial report.
A. Yes.
Q. Will you please look at the year 1999.
A. Yes.
Q. Is there data available there?
A. Yes.
Q. For New River MCAF?
A. Yes.
Q. Can you explain the discrepancy, please.
A. I cannot.
Q. Okay. How about the year 2000? Can you look at the year 2000 on the spreadsheet that you produced?
A. Yes.
Q. Is there data available there?
A. No.
Q. Okay. Can you look at the year 2000 on Table 1 of your initial report.
A. Yes.
Q. In the New River MCAF column, is there a value there?

A. No -- or excuse me -- yes.
Q. It's 50.4; right?
A. That's correct.
Q. Inches per year?
A. Correct.
Q. Where did you get that data from?
A. I -- I'm not sure why there's a discrepancy here.
Q. Okay.
A. I'd have to investigate it.
MR. ANTONUCCI: I'd like to take another break.
THE VIDEOGRAPHER: We're off the record. The time is 3:47.
(There was a break taken.)
THE VIDEOGRAPHER: We're back on the record. The time is 4:06.
Q. BY MR. ANTONUCCI: Dr. Jones, you stated in your initial report that larger errors tend to be concentrated in the center of the plume where the simulated concentrations are greater; is that right?
A. Yes.
Q. You also said that that's

somewhat expected because comparing larger numbers organically results in larger differences; right?

A. Yes.

Q. Concentrations are generally higher in the center of a plume; right?

A. Yes.

Q. Could you please turn your attention to Rebuttal Figure A9. That's going to be Exhibit 7.

A. Okay.

Q. Please look at the center pane of this figure, Model Layer 3. Are you looking there?

A. Yes.

Q. Do you see model -- excuse me -- do you see Well C5, the plot for Well C5?

A. Yes.

Q. And that is within the simulated PCE plume; right?

A. Correct.

Q. And it's in the portion of the simulated PCE plume where concentrations are greater than 500 to 5,000 micrograms per

liter; right?
A. That's correct.
Q. Okay. That's the center of the plume; right?
A. Yes.
Q. I'd like you to turn to Rebuttal Table A1.
A. Okay.
Q. And if you could please look at the first two pages of Table A1 in Exhibit 7.
A. Which page number?
Q. So Page 1. The page number is Page 1 of 7.
A. Okay.
Q. And...
A. I got it.
Q. All right. If you look towards the bottom of Page 1 of 7, Table A1?
A. Yes.
Q. Well C5 is the last four rows of this table; right?
A. Yes.
Q. And this shows observed versus simulated concentrations with the error rate and the absolute error rate; correct?

A. That's correct.

Q. All of the observed PCE concentrations for Well C5 are below the detection limit; isn't that right?

A. That's correct.

Q. Okay. And then continuing on to Page 2 of Table A1, we're still looking at Well C5. That's going to be the first seven rows of this table?

A. Yes.

Q. All of the PCE observed concentrations were below the detection limit here as well; right?

A. That's correct.

Q. The calibrated model and the post-audit both simulated high PCE concentrations at that well, didn't they?

A. Yes.

Q. Still in Exhibit 7, your rebuttal report, I'd like you to turn to Page 3-13.

A. Okay.

Q. All right. Under Section 3.7, Opinion 6 - Post-Audit Robustness. I am looking at the second full paragraph.

Do you see that?

A. Yes.

Q. Okay. The last sentences of that paragraph reads "These findings support our original conclusion that the ATSDR model was developed using a methodology that is scientifically sound and accepted within the scientific community, and it remains a reliable tool for assessing the impacts of PCE contamination at Tarawa Terrace."

Did I read that correctly?

A. Yes.

Q. Okay. Dr. Jones, in the post-audit you used the model input parameters that were provided to you by the legal team; right?

A. Yes.

Q. And you did not independently evaluate the suitability of those parameters; correct?

A. The -- the parameters in the -- you mean as part of the post-audit? Can you restate the question, I'm sorry.

Q. You did not evaluate the appropriateness of the model input

parameters; correct?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I wouldn't say that.

Q. BY MR. ANTONUCCI: You used the model input parameters that were provided to you by the legal team; right?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Yes, we did.

Q. BY MR. ANTONUCCI: Okay. Dr. Jones, earlier in the deposition you mentioned that you were present via Zoom for the deposition of Mr. Davis yesterday; is that correct?

A. That's correct.

Q. You mentioned that you weren't present for the entire deposition; is that right?

A. That's right.

Q. At what times were you watching the deposition?

A. From about 9:00 to 9:25 a.m., and then I jumped on again about 10:50 a.m.

and watched the remainder of the deposition.

Q. Do you disagree with any of the opinions that Dr. Jones expressed in his deposition -- excuse me -- that Mr. Davis expressed in his deposition?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I -- I'm not going to say that everything he said was precise or exactly the way I would have said it, but the general statements he gave, I -- I think I would agree with that.

Q. BY MR. ANTONUCCI: Were any of the statements that Mr. Davis gave incorrect?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: I'm not prepared to cite specific examples.

Q. BY MR. ANTONUCCI: Can you think of a single instance where Mr. Davis made an incorrect statement in his deposition?

MS. BAUGHMAN: Objection. Form.

THE WITNESS: Nothing substantive.

Q. BY MR. ANTONUCCI: Can you think of any non-substantive errors in Mr. Davis' deposition testimony?

MS. BAUGHMAN: Objection to form.

THE WITNESS: Not that I could recite off the top of my head.

Q. BY MR. ANTONUCCI: What do you mean by "substantive"?

A. Well, I -- I believe there was one case where he was talking about the -- when we did the post-audit and he talked about the calibration target relative to Well TT-26.

In fact, we did not have any observations at Well TT-26 during the extended simulation period, so that was not a correct statement. That's the one that I can recall, and I believe he may have corrected himself, but...

Q. Dr. Jones, how much have you billed to date in this case?

MS. BAUGHMAN: Objection to

form. We've provided the bills.

THE WITNESS: I've billed the amount shown in the invoices that we submitted.

Q. BY MR. ANTONUCCI: Do you know what that amount is?

MS. BAUGHMAN: Object to form.

THE WITNESS: I think through the end of January it would be roughly $120,000, I believe.

Q. BY MR. ANTONUCCI: Does your payment depend on the outcome of this case?

A. No.

MR. ANTONUCCI: Okay. I am going to show you another exhibit. This will be Exhibit 18.

(Exhibit 18 was marked for identification.)

Q. BY MR. ANTONUCCI: This document has the title "An overview of current applications, challenges, and future trends in distributed process-based models in hydrology"; is that right?

A. Correct.

Q. There's a list of several authors here, one of them being Norm Jones.

Is that you?
A. That's me.
Q. Okay. Were you an author of this study?
A. I was a co-author.
Q. Okay. Please turn your attention to Page 5 of Exhibit 18.
A. Okay.
Q. I'm looking at the very last sentence on the page starting with the word "Although." It's -- it continues on to Page 6.
A. Oh, okay, sure.
Q. Okay. So this says "Although some of those process-based hydrological models include numerous distinct processes, the degree of complexity and quantity of processes represented varies between models and influences the suitability of a given model for specific applications."
Did I read that correctly?
A. Yes.
Q. You'd agree that a model cannot capture the complexity of aquifer conditions completely; right?

A. Yes.

Q. That they don't necessarily reflect all real-world conditions; right?

A. A model, as we've discussed earlier, is a simplification of reality.

Q. Okay. Would it be possible for you to have performed a post-audit on the Hadnot Point/Holcomb Boulevard model?

A. Yes, I assume it would be possible.

Q. Okay. And you did not do it because you weren't asked to by the legal team; right?

A. That's correct.

Q. Okay. Finally, I'd -- I'd like to turn back to our earlier discussion of the model's ability to predict contaminant concentrations at TT-26 accurately.

Do you remember discussing that?

A. I -- we've discussed that topic quite a few times today. In general, yes, I remember discussing that.

Q. Okay. It's true that the ATSDR used a mass balance model for determining

concentrations at the water treatment plant; right?

A. That's correct.

Q. Okay.

A. Based on the concentrations and pumping rates at the supply wells.

Q. It's also true that you did not have information on the pumping rates for all times during this study period; correct?

MS. BAUGHMAN: Objection. Form.

Q. BY MR. ANTONUCCI: Excuse me.

It's true that ATSDR did not have information on pumping rates during all times of the study period; correct?

MS. BAUGHMAN: Objection. Form and foundation.

THE WITNESS: Yes, that is very standard for groundwater modeling projects.

Q. BY MR. ANTONUCCI: Okay. Would the process of performing a post-audit for Hadnot Point/Holcomb Boulevard be different than performing a post-audit for Tarawa Terrace?

A. The basic process would be the same. It would be extended over a -- the model inputs would be extended over a new period. We would not change anything in the original models, other than extending it, and then run the simulations and compare the predicted results of the extended model with any new field observed value data that were available, is the general process.

Q. The -- the -- ATSDR's calibrated model's geometric model bias was lower when considering Well TT-23; right?

A. That's correct.

Q. That's because the ATSDR's calibrated model demonstrated a worse fit between simulated and observed conditions at that well?

A. I think that's safe to say, yes. Well, actually, the reason why -- I'm not comfortable saying they didn't consider it because it had a worse fit. I would say that the difference in the geometric bias between the two, the fact that it goes down if you don't include it would indicate that it -- it has a high fit at that. But I -- I

recall there were -- there were a couple of reasons why they argued why it may not be considered, but they presented both values for consideration, so...

Q. Okay. So then ATSDR's calibrated model had a sort of variable fit between observed and simulated data at different supply wells; isn't that right?

A. Yes.

Q. Okay. Dr. Jones, I think we're coming up on the end of my questions. Are there any answers you've given to my questions you wish to change before we end this deposition?

A. Not that I can think of.

Q. Is there any information I asked you about that you didn't recall at the time but now remember?

A. No.

Q. Were there questions I asked that you did not understand in which I was unable to clarify?

A. Not that I recall.

Q. Once it's ready, you will be provided with a transcript of this

deposition. We ask you carefully read, correct, and sign it.
Do you understand that?
A. Yes.
MR. ANTONUCCI: Well, thank you, Dr. Jones, for your patience in answering my questions today.
I pass the witness.
THE WITNESS: Thank you.
MS. BAUGHMAN: Dr. Jones, I just have a few questions for you.

EXAMINATION

BY MS. BAUGHMAN:
Q. First, let's go to Exhibit 6 of your -- Exhibit 6, which is your original post-audit. And if you could turn to Page 5-1.
A. Sure.
Q. Okay. And I think you may remember earlier that counsel for DOJ asked you some questions about -- or he read parts of Numbers 1 through 4 under your results and asked if he'd read it correctly and if these things were true.
Do you recall that?

A. Yes.

Q. Okay. And so what you have here under Section 5 Results is you wrote "Before presenting the results, it is helpful to remember that when simulating the migration of a PCE contaminant plume using MODFLOW and MT3DMS, achieving a close match between simulated and observed concentrations can be challenging for several reasons:" And you listed four reasons; correct?

A. Yes.

Q. Now, I'm going to ask about each of them individually, but is your observation that when simulating the migration of a PCE contaminant plume using MODFLOW and MT3DMS, when doing that achieving a close match between simulated and observed concentrations can be challenging, is that limited to Camp Lejeune and the ATSDR's modeling efforts?

A. No.

Q. What -- to what extent does that apply to groundwater modeling?

A. The contaminant transport modeling with MT3DMS, there's always -- or

there's typically a very high variability in the observed concentration data. And the -- the model simulates a plume representing average conditions over the grid cells and using some simplifying assumptions.

And so you shouldn't expect it to -- to precisely match the observed concentrations at each instance, rather the overall level of fit is what is most important to analyze.

Q. And that's true whenever you're modeling a plume using MODFLOW and MT3DMS; right?

A. That's correct.

Q. Okay. So if we go to the first factor, you wrote that "The subsurface environment is inherently complex, with variations in soil heterogeneity, permeability, porosity, and hydraulic conductivity. These properties vary spatially in ways that are not fully captured in the model, affecting how the contaminant plume moves throughout the groundwater system."

Is that observation specific to

Camp Lejeune and the ATSDR modeling efforts?
A. No.
Q. Is that statement regarding complex subsurface conditions generally true for groundwater modeling efforts using MODFLOW and MT3DMS?
A. Yes.
Q. Okay. Or using any model?
A. Yes.
Q. Okay. Your second factor listed is "Temporal Variability," and you wrote "The concentration of contaminants can change over time due to factors like seasonal variations in groundwater flow, biodegradation, and chemical reactions. Simulating these dynamic processes accurately over the entire simulation period is challenging."
Is that observation specific or unique to Camp Lejeune and the ATSDR's modeling efforts?
A. It's a -- it's a general statement that would be true of any contaminant transport model.
Q. At any location?

A. Yes.
Q. By any modeler?
A. Yes.
Q. Okay. Your third reason listed is "Limitations in Model Resolution." And you wrote "MODFLOW and MT3DMS rely on discretizing the subsurface into numerical grids consisting of cells that represent a subset of the aquifer. The resolution of these grids can limit the model's ability to capture fine-scale variations in plume behavior, particularly in areas with sharp concentration gradients, small-scale heterogeneities, or preferential pathways."
Is that observation specific to ATSDR's modeling efforts at Camp Lejeune?
A. No, it's a general statement, and I think there's evidence of this specifically at Camp Lejeune.
Q. But the limits in modeling -- limitations of model resolution that you've described here is a limitation that would apply whenever this type of modeling is done with MODFLOW and MT3DMS?
A. Correct.

Q. Okay. And the fourth factor you listed is "Measurement Variability," and you wrote "The observed concentrations at observation wells may contain some degree of measurement error uncertainty. Field data collection is subject to variability, which adds another layer of complexity when trying to match it closely with model outputs."

Is that observation unique to ATSDR's efforts at Camp Lejeune?

A. No.

Q. Is it a general issue on measurement variability that applies in all groundwater modeling efforts?

A. That's correct.

Q. Okay. You were asked, I think, on numerous occasions today by DOJ's counsel for what purpose ATSDR's modeling effort can be used, and I want to ask you this: Can ATSDR's model be used to determine -- let me strike that.

Is ATSDR's model or models used for Camp Lejeune sufficiently reliable to determine the mean monthly concentrations at the water treatment plant at Tarawa Terrace

based on the work that you've done in this case?

A. Yes, I believe so.

Q. And was it necessary for you or for the ATSDR modelers to know how those mean monthly concentrations would be used by any health professional, including an epidemiologist or a toxicologist or a medical doctor, in order to conduct the modeling efforts appropriately?

A. I can't think of any circumstances in how they would be used that would alter the modeling process that went about building the model and generating those simulated concentrations at the water treatment plant.

Q. So, in other words, if a MD, PhD, epidemiologist, medical doctor wanted to use the mean monthly concentrations to estimate an individual exposure as opposed to a group exposure, would that change how you or Morris Maslia or anyone else conducts the modeling?

MR. ANTONUCCI: Objection.

THE WITNESS: No.

Q. BY MS. BAUGHMAN: You were asked a number of questions by DOJ counsel regarding -- about geometric bias.
Do you recall that?
A. Yes.
Q. Do you know what the geometric bias was that was calculated for the concentrations at the water treatment plant for Tarawa Terrace?
A. Yes.
Q. What was that?
A. 1.5.
Q. And that's -- what's your opinion of that in terms of, you know, good, bad, accurate, inaccurate, do you have an opinion?
A. I would say in the context of contaminant transport modeling that would be a slight high bias.
Q. Okay. And did you calculate the geometric bias related to your post-audit work?
A. Yes.
Q. And what was that geometric bias?

A. I calculated geometric bias for the 318 observations, and the geometric bias was 2.1, which is substantially lower than the 3.9 to 5.9 range that they got with the original model.

And if you look solely at observation -- observation -- concentrations at observation wells that are greater than 5 micrograms per liter, that bias drops to 1.2.

Q. And remind me, 5 micrograms per liter, why is that number significant?

A. It's the minimum -- it's the MCL.

Q. Maximum contaminant --

A. Maximum contamination level, yes.

Q. Set by the EPA?

A. That's correct.

MS. BAUGHMAN: Okay. I'll pass the witness.

EXAMINATION

BY MR. ANTONUCCI:

Q. Dr. Jones, you just testified that the geometric model bias at the Tarawa

Terrace water treatment plant was 1.5; is that correct?

A. That's correct.

Q. Where did you get that value from?

A. From the modeling reports. ATSDR modeling reports.

Q. Okay. Can you tell me where specifically in the modeling reports you got that value from?

A. Well, earlier this afternoon you had me read from a table, and it was in that table and a discussion of that was in the prior page. I believe it's in -- you can find it in Chapter A, if I recall correctly.

Q. Okay. And you also testified that the geometric model bias of your post-audit was 2.1; is that correct?

A. That's correct.

Q. It's true that you calculated a geometric model bias but not a mean absolute error of your post-audit; is that right?

A. I -- there is a mean absolute error calculated, I just can't remember what it was off the top of my head.

Q. Okay. And it's not in your report; correct?
A. No, we did not put it in the report.
MR. ANTONUCCI: Okay. All right. I pass the witness.

EXAMINATION

BY MS. BAUGHMAN:
Q. The geometric bias, is there -- is there a table or a figure in your report from which one could easily calculate the geometric bias for the post-audit work?
A. Yes. If you take the simulated versus observed PCE concentrations at the 318 well locations, it's -- it's a simple spreadsheet calculation.
Q. And all of the data necessary to do that is in your report?
A. That's correct.
Q. Where? Where?
A. It's the -- well, the most recent and correct version of that would be in table -- Table A1 of the rebuttal report.
MS. BAUGHMAN: Okay. Thank you.

I'll pass the witness.

MR. ANTONUCCI: All right. Thank you, Dr. Jones, no further questions.

THE WITNESS: Okay. Thank you.

MS. BAUGHMAN: I think we're finished. Thank you.

THE VIDEOGRAPHER: We're off the record. The time is 4:34.

(The deposition was concluded at 4:34 p.m.)

-oOo-

Reporter's Certificate

State of Utah)
County of Salt Lake)

I, Vickie Larsen, Certified Court Reporter and Registered Merit Reporter in the State of Utah, do hereby certify:

THAT the foregoing proceedings were taken before me at the time and place set forth herein; that the witness was duly sworn to tell the truth, the whole truth, and nothing but the truth; and that the proceedings were taken down by me in shorthand and thereafter transcribed into typewriting under my direction and supervision;

THAT the foregoing pages contain a true and correct transcription of my said shorthand notes so taken.

IN WITNESS WHEREOF, I have subscribed my name this 19th day of February, 2025.

Vickie Larsen

Vickie Larsen, CCR/RMR
Utah License No. 109887-7801
Nevada License No. 966

In Re: Camp Lejeune Water Litigation
Case No.: 7:23-CV-00897
Date: February 14, 2025
Reporter: Vickie Larsen, CCR/RMR

WITNESS CERTIFICATE

State of Utah)
ss.
County of Salt Lake)

I, NORMAN L. JONES, HEREBY DECLARE: That I am the witness referred to in the foregoing testimony; that I have read the transcript and know the contents thereof; that with these corrections I have noted this transcript truly and accurately reflects my testimony.

PAGE-LINE	CHANGE/CORRECTION	REASON
____ ____	______________________	_____
____ ____	______________________	_____
____ ____	______________________	_____
____ ____	______________________	_____
____ ____	______________________	____
____ ____	______________________	_____
____ ____	______________________	_____
____ ____	______________________	_____

_____ No corrections were made.

I, NORMAN L. JONES, hereby declare under the penalties of perjury of the laws of the United States of America and the laws of the State of Utah that the foregoing is true and correct.

Dated this ______day of _______________, 2025.

____
NORMAN L. JONES

e